Aviation Week

Including Space Technology

A McGRAW-HILL PUBLICATION

FEBRUARY 24, 1958

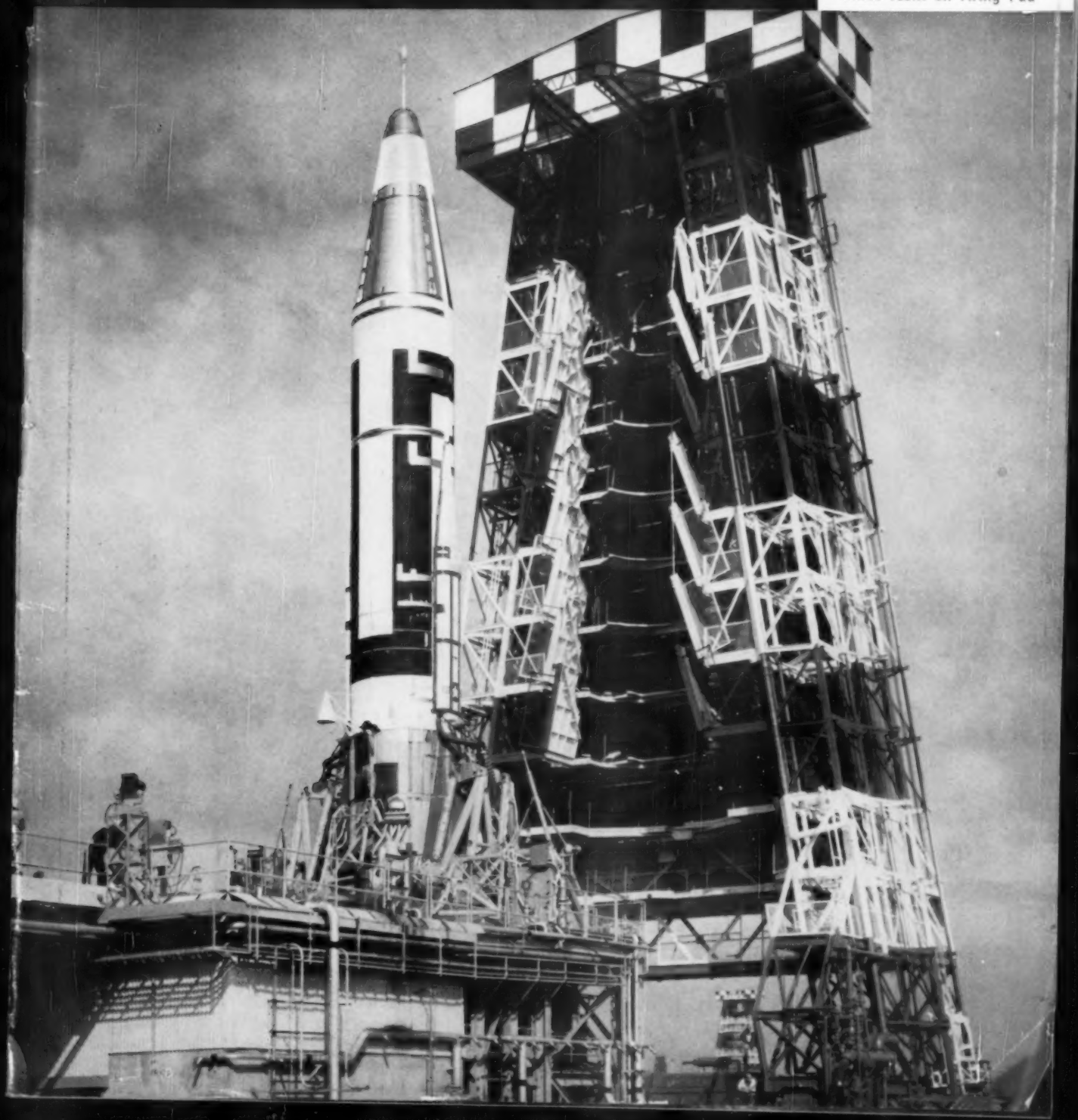
75 cents

Space May Revive Biplane, Triplane

●

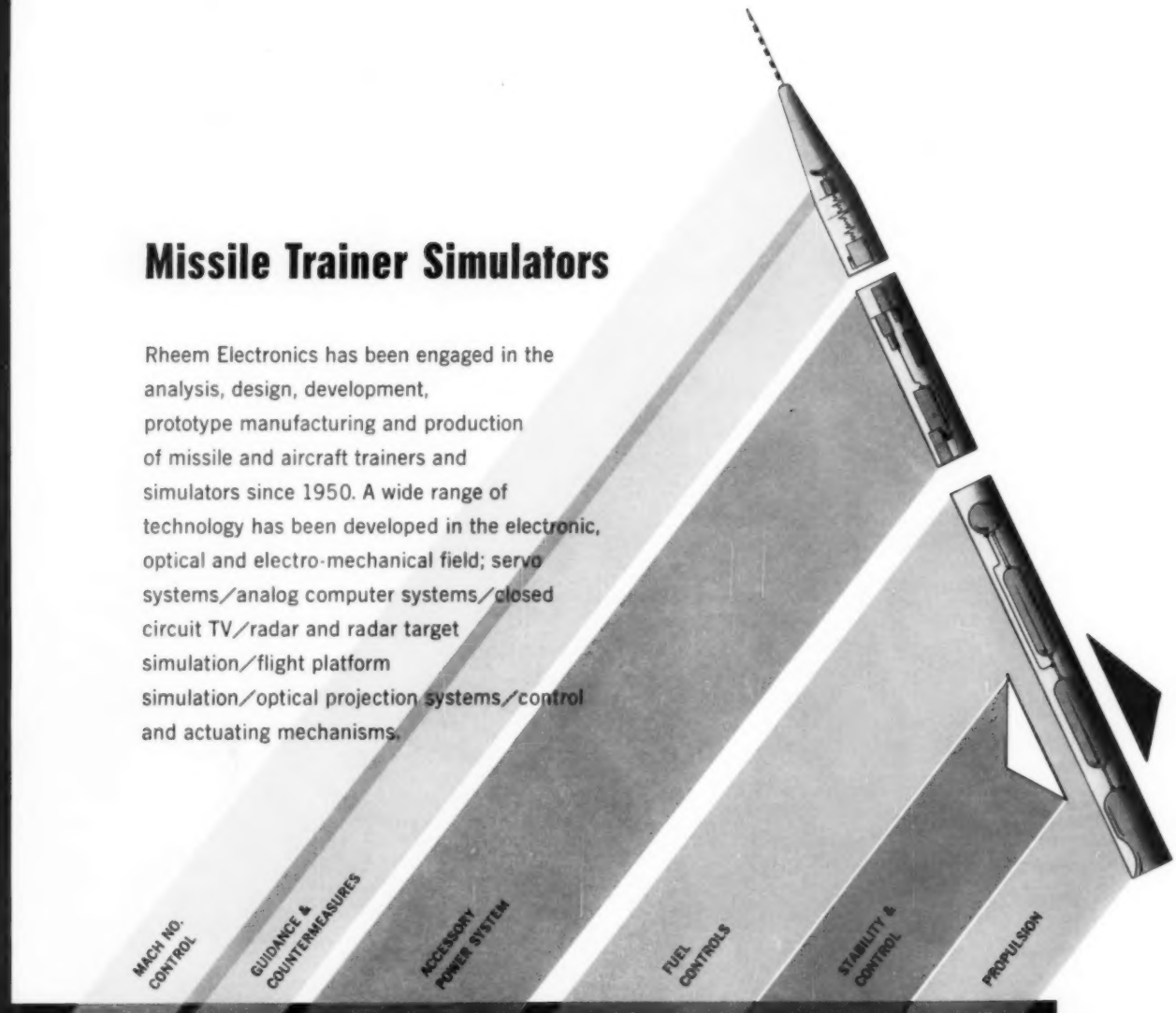
USAF, Army Argue Anti-Missile Role

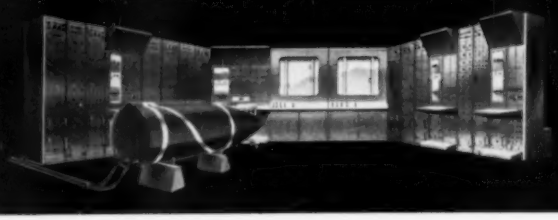
Atlas ICBM on Firing Pad



Missile Trainer Simulators

Rheem Electronics has been engaged in the analysis, design, development, prototype manufacturing and production of missile and aircraft trainers and simulators since 1950. A wide range of technology has been developed in the electronic, optical and electro-mechanical field; servo systems/analog computer systems/closed circuit TV/radar and radar target simulation/flight platform simulation/optical projection systems/control and actuating mechanisms.



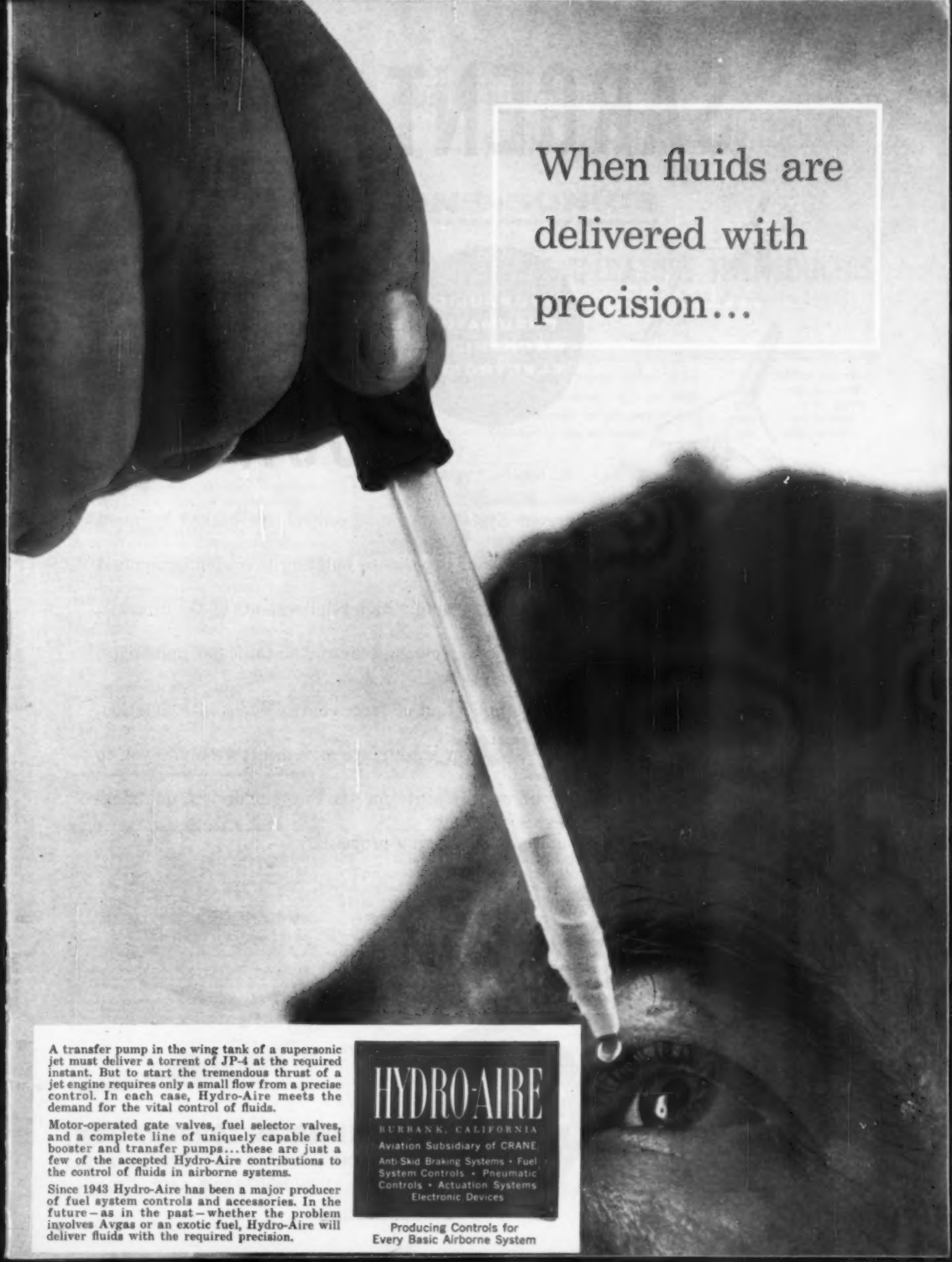


The test console depicts a typical simulation device utilized for the "dry run" of a missile and its components; significant advances have been made in the art of simulation to train personnel in missile operations.

RHEEM MANUFACTURING COMPANY/ELECTRONICS DIVISION

Rivera, California

Rheem



A transfer pump in the wing tank of a supersonic jet must deliver a torrent of JP-4 at the required instant. But to start the tremendous thrust of a jet engine requires only a small flow from a precise control. In each case, Hydro-Aire meets the demand for the vital control of fluids.

Motor-operated gate valves, fuel selector valves, and a complete line of uniquely capable fuel booster and transfer pumps...these are just a few of the accepted Hydro-Aire contributions to the control of fluids in airborne systems.

Since 1943 Hydro-Aire has been a major producer of fuel system controls and accessories. In the future—as in the past—whether the problem involves Avgas or an exotic fuel, Hydro-Aire will deliver fluids with the required precision.

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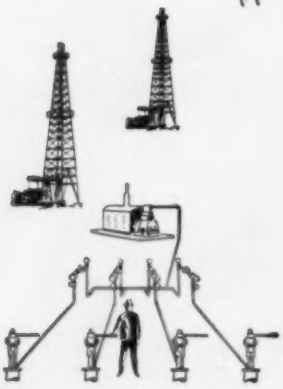

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AVIATION CALENDAR

Mar. 3-6—Third Annual American Society of Mechanical Engineers Gas Turbine Conference and Exposition, Shoreham Hotel, Washington, D. C.

Mar. 4-6—Sixth Annual Air Line Pilots Assn. Air Safety Forum, Hotel Shoreland, Chicago, Ill.

Mar. 5-6—Second Annual Shock Tube Symposium, Palo Alto, Calif. For details write: Commander, Air Force Special Weapons Center, Kirtland AFB, N. W., Atten.: R. R. Birukoff, SWRS.

Mar. 11—"The Rocket and the Reaction Principle," Kurt Stehling, The Franklin Institute, Philadelphia, Pa.

Mar. 13-14—Institute of the Aeronautical Sciences, National Flight Propulsion Meeting (Secret clearance required), Hotel Carter, Cleveland, Ohio.

Mar. 13-14—Fifth Annual Heat Transfer Technical Conference, Oklahoma State University, Stillwater, Okla.

Mar. 13-14—Second National Conference on Aviation Education, Hotel Mayflower, Washington, D. C.

Mar. 16-20—Joint Aviation Conference, American Rocket Society-American Society of Mechanical Engineers, Statler-Hilton Hotel, Dallas, Tex.

Mar. 17-21—Third Colloquium, Combustion and Propulsion Panel, Advisory Group for Aeronautical Research and Development, NATO, Palermo, Sicily.

Mar. 17-21—1958 Nuclear Congress, 25 W. 45 St., New York City.

Mar. 17-21—14th Annual Conference, National Assn. of Corrosion Engineers, Civic Auditorium, San Francisco, Calif.

Mar. 18-19—Conference on extremely high temperatures (over 30,000K), sponsored by USAF Cambridge Research Center, L. G. Hanscom Field, Bedford, Mass.

Mar. 18-19—First Inter-Service and Industry

(Continued on page 6)

AVIATION WEEK • FEBRUARY 24, 1958

Vol. 68, No. 8

Published weekly with an additional issue in December by McGraw-Hill Publishing Company. James H. McGraw (1860-1948), Founder. Executive, Editorial, Advertising and Subscription offices: **McGraw-Hill Building, 330 West 42nd Street, New York 36, N. Y.** Publication Offices, 99-129 North Broadway, Albany 1, N. Y. Donald C. McGraw, President; Joseph A. Gerardi, Executive Vice President; L. Keith Goodrich, Vice President and Treasurer; John J. Cooke, Secretary; Nelson Bond, Executive Vice President, Publications Division; Ralph B. Smith, Vice President and Editorial Director; Joseph H. Allen, Vice President and Director of Advertising Sales; A. R. Venezian, Vice President and Circulation Coordinator.

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REG. T.M.

SURFACE TEMPERATURE TRANSDUCERS

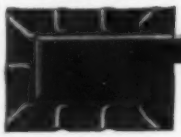
actual size

CEMENT-ON*, Type 1375

The temperature sensing element is encased by a die-formed wire screen which can be installed on any surface with TRANS-SONICS Type 64C cement.

TYPE	TEMPERATURE RANGE
1375A	−300 to +650F.
1375B	0 to 1000F.
1375C	+200 to 1250F.
1375D	+500 to 1550F.

actual size



WELD-ON*, Type 1376

The temperature sensing element is encased in a thin die-formed metal cover, and is installed by spot welding the cover to the underlying metallic surface.

TYPE	TEMPERATURE RANGE
1376A	−300 to +650F.
1376B	0 to 1000F.
1376C	+200 to 1250F.
1376D	+500 to 1550F.

- **RANGES:** From −400F to +1550F.
- **OUTPUT:** Up to 5 volts without amplification.
- **RESISTANCE CHANGE:** 100 ohms over calibrated range.
- **ACCURACY OF CALIBRATION:** ±1% of range interval ±2% for temperatures over 1000F.
- **MAXIMUM CONTINUOUS CURRENT:** 20 milliamperes rms.
- **REPEATABILITY:** ±0.2% of range interval.
- **VIBRATION:** 1-inch double amplitude, 0-22 cps; 25g, 22-2000 cps.
- **ACCELERATION & SHOCK:** 100g on all three major axes.
- **LEADS:** Two 6" nickel wires with high temperature insulation.

Trans-Sonics Cement-On Type 1375 and Weld-On Type 1376 Surface Temperature Transducers are platinum resistance thermometers that can be installed on any surface, flat or curved, metallic or non-metallic, for accurate temperature measurement. The protective cover of the resistive element is cemented or welded directly to the thermal surface to form an isothermal system which gives a transducer reading that corresponds to the true skin temperature.

A 5 point resistance-temperature calibration certificate at 0, ¼, ½, ¾ and full scale temperature is supplied with each transducer. A strip of aluminum Thermotape* is also furnished with each unit to provide an alternate means of tape-on installation useful to 800F and under limited conditions to 1000F.

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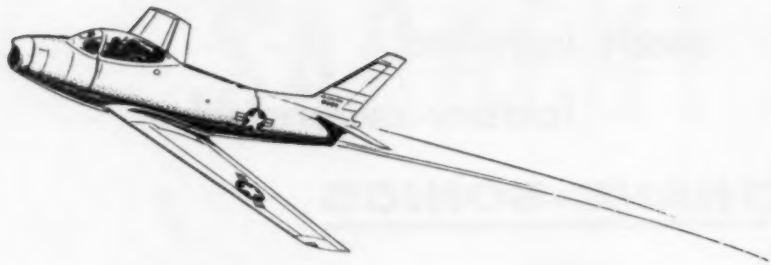
Precision Transducers



Another famous plane

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1951

North American F86E "Sabre" Jets help U.N. forces in Korea ring up 14-1 kill ratio over Russian-built MIG's.

In 1951, the dependable Sabre jet was proving itself daily in Korean air battles. Development of the F86 is typical of the tremendous strides made by the aviation industry.

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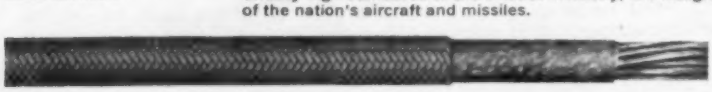
Today many Rockbestos Aviation Wires, produced to the continually high standards of the aviation industry, are integral parts of the nation's aircraft and missiles.



Typical of the many Rockbestos Aviation Wires which cover a temperature range from 257°F to 750°F is this Rockbestos HEATZONE® — a 400°F wire for power, control and communication circuits made in accordance with MIL-W-7139A. It is ideal for general purpose aircraft wiring because it has excellent resistance to flame, moisture, gasoline, fungus, alcohol, grease, oil and hydraulic fluids. It has high dielectric strength and excellent flexibility at low temperatures (—55°C). It is especially recommended for high impedance circuits.

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AVIATION CALENDAR

(*Continued from page 5*)

Symposium on Guided Missiles Training Equipment (limited to those with Secret clearance), Naval Ordnance Laboratory, White Oaks, Silver Springs, Md. For details write Mr. J. G. Vaeth, Head of New Weapons & Systems Division, U. S. Naval Training Device Center, Port Washington, N. Y.

Mar. 20—Luncheon meeting, Chicago Assn. of Commerce and Industry's Aviation Committee, Hotel Sherman, Chicago, Ill. Speaker: Gen. Thomas S. Power, Commander-in-Chief of the Strategic Air Command.

Mar. 24-26—Annual Meeting, Aero Medical Assn., Statler Hotel, Washington, D. C.

Mar. 24-27—Institute of Radio Engineers, National Convention, Waldorf-Astoria Hotel and New York Coliseum, New York City.

Mar. 31-Apr. 4—American Management Assn., Management Methods for Professional People Seminar, Sheraton-Astor Hotel, New York City.

Apr. 8-10—Eighth International Symposia, Electronic Waveguides, Engineering Societies Bldg., 29 W. 39 St., New York City.

Apr. 8-11—National Aeronautic Meeting, Society of Automotive Engineers, Inc., Hotel Commodore, New York, N. Y.

Apr. 10-11—Aeronautical Training Society Annual Meeting, Mayflower Hotel, Washington, D. C.

Apr. 10-12—Southwestern Institute of Radio Engineers Conference and Electronic Show, St. Anthony Hotel and Municipal Auditorium, San Antonio, Tex.

Apr. 16—"Inductive Testing Requirements of Contacts Used in Aircraft Electric Systems," M. Trbovich, Hartman Electrical Mfg. Co., Engineers Club, Philadelphia

Apr. 16-19—14th Annual National Forum, American Helicopter Society, Sheraton-Park Hotel, Washington, D. C.

Apr. 17-18—Institute of Environmental Engineers, Second Annual Technical Meeting, New Yorker Hotel, New York City.

Apr. 22-24—1958 Electronic Components Conference, Ambassador Hotel, Los Angeles, Calif.

Apr. 28-30—Second Annual Astronautics Conference, sponsored by Air Force Office of Scientific Research and Institute of Aeronautical Sciences, Shirley Savoy Hotel, Denver, Colo.

May 4-7—Fourth National Flight Test Instrumentation Symposium, Park Sheraton Hotel, New York City.

May 12-14—National Conference on Aeronautical Electronics, sponsored by Institute of Radio Engineers, Biltmore Hotel, Dayton, Ohio.

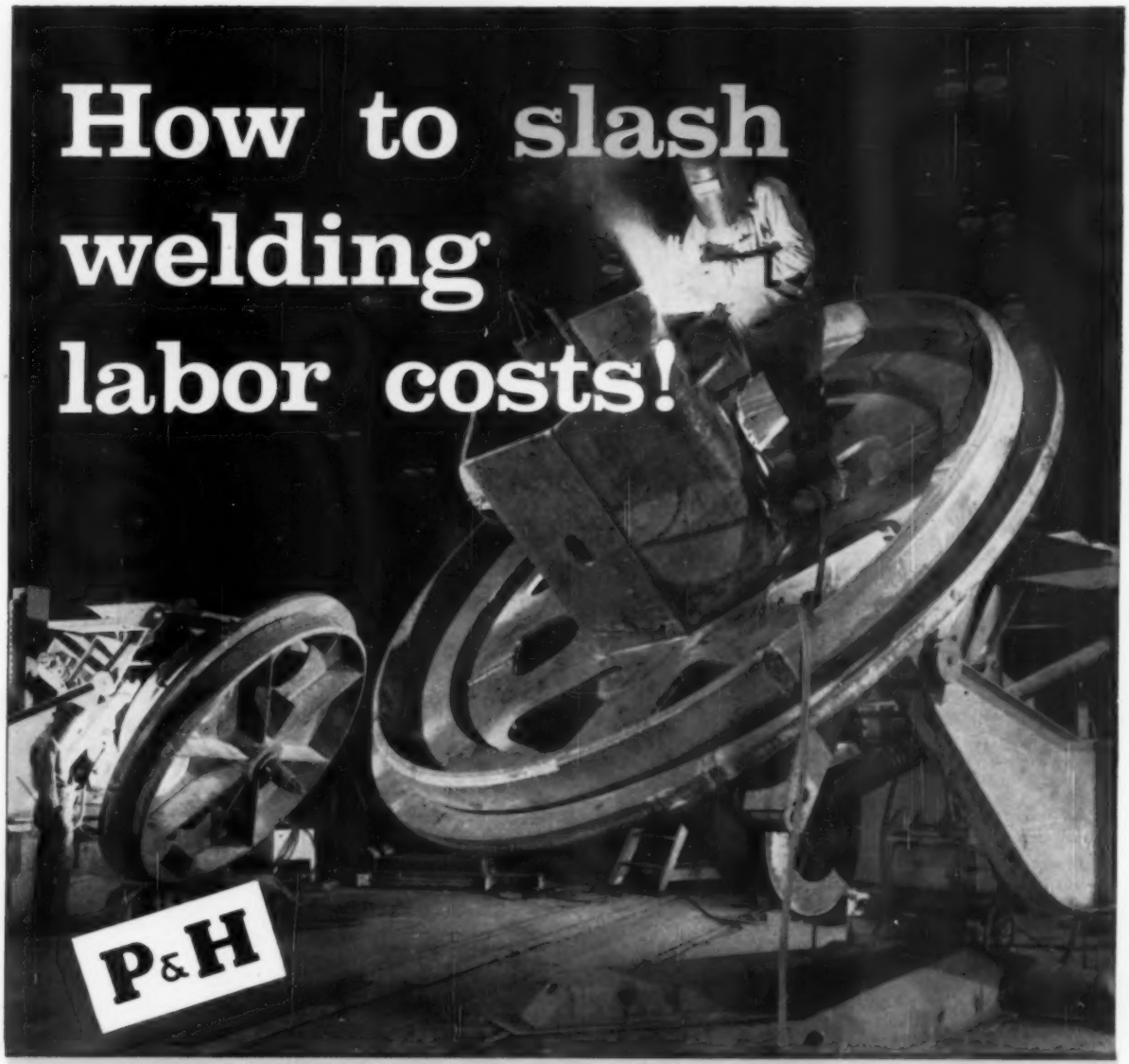
May 14-16—Spring Meeting, Society for Experimental Stress Analysis, Hotel Manger, Cleveland, Ohio.

May 19-22—17th Annual National Conference, Society of Aeronautical Weight Engineers, Inc., Belmont Plaza Hotel, New York, N. Y.

June 2-4—1958 National Telemetering Conference, Lord Baltimore Hotel, Baltimore.

June 9-13—Fourth International Automation Exposition and Congress, Coliseum, N. Y., N. Y.

How to slash welding labor costs!



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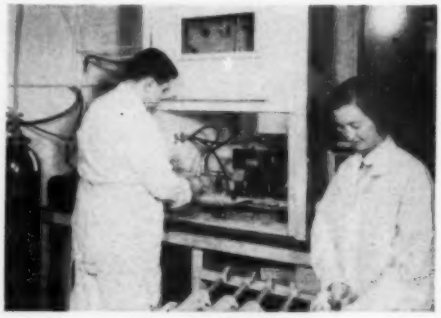

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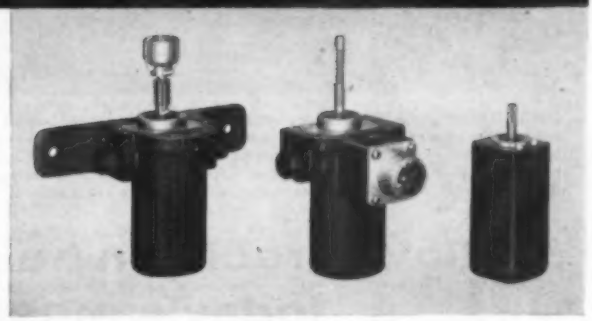

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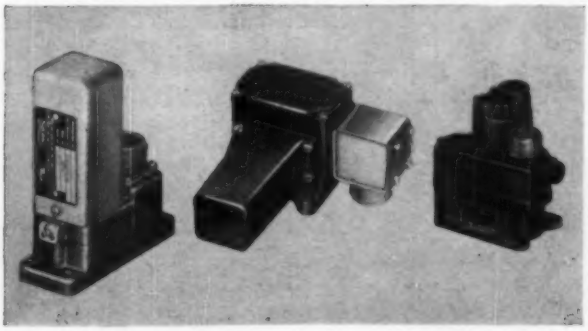

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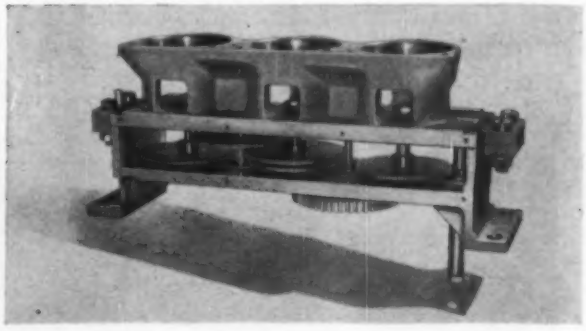

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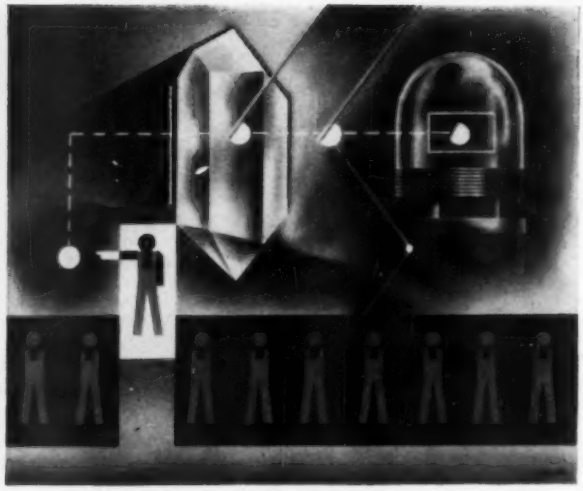

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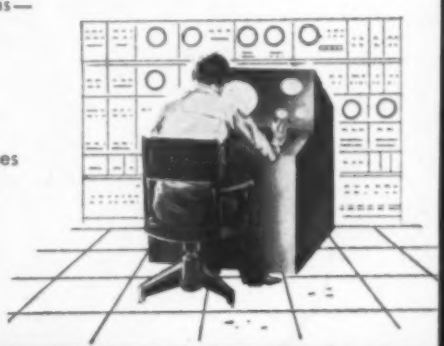

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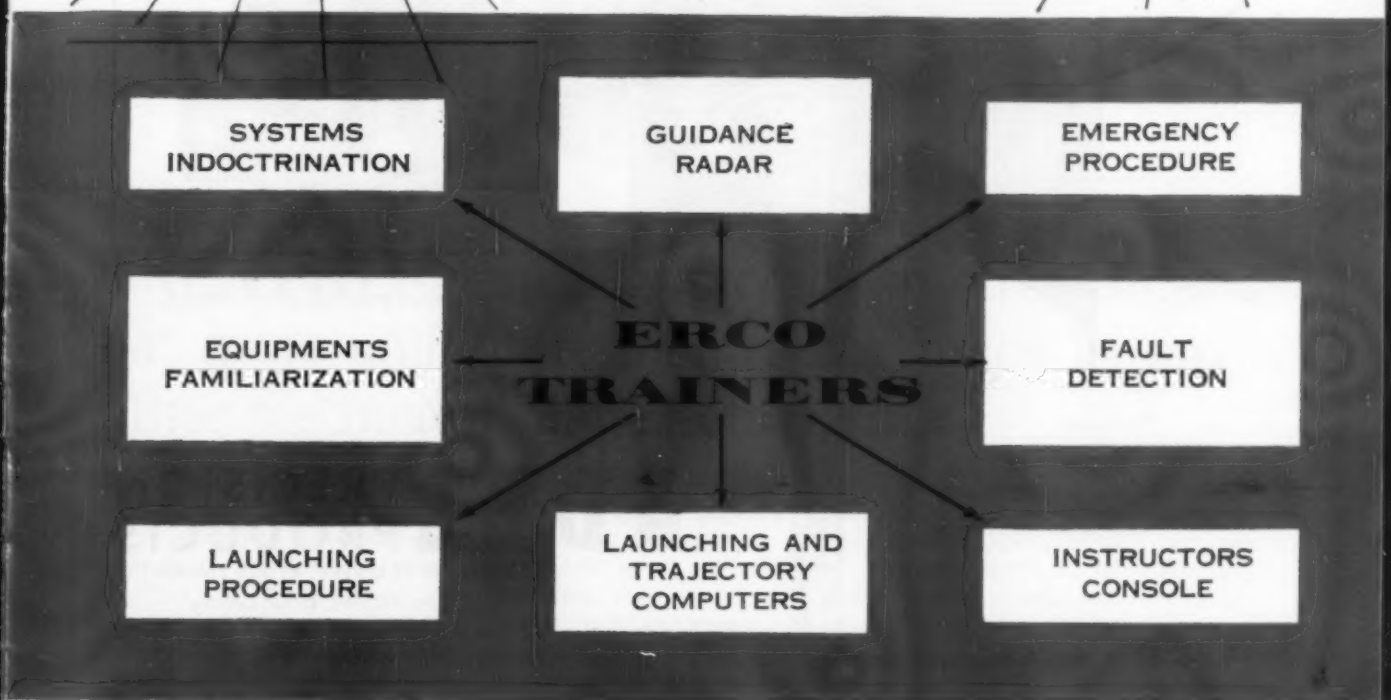

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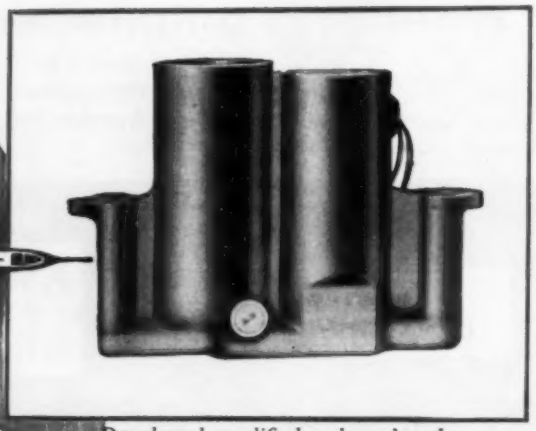

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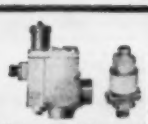
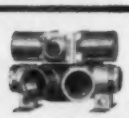
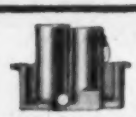
ADEL designs and manufactures aircraft products in the following major categories:


Hydraulic & Pneumatic Control Equipment

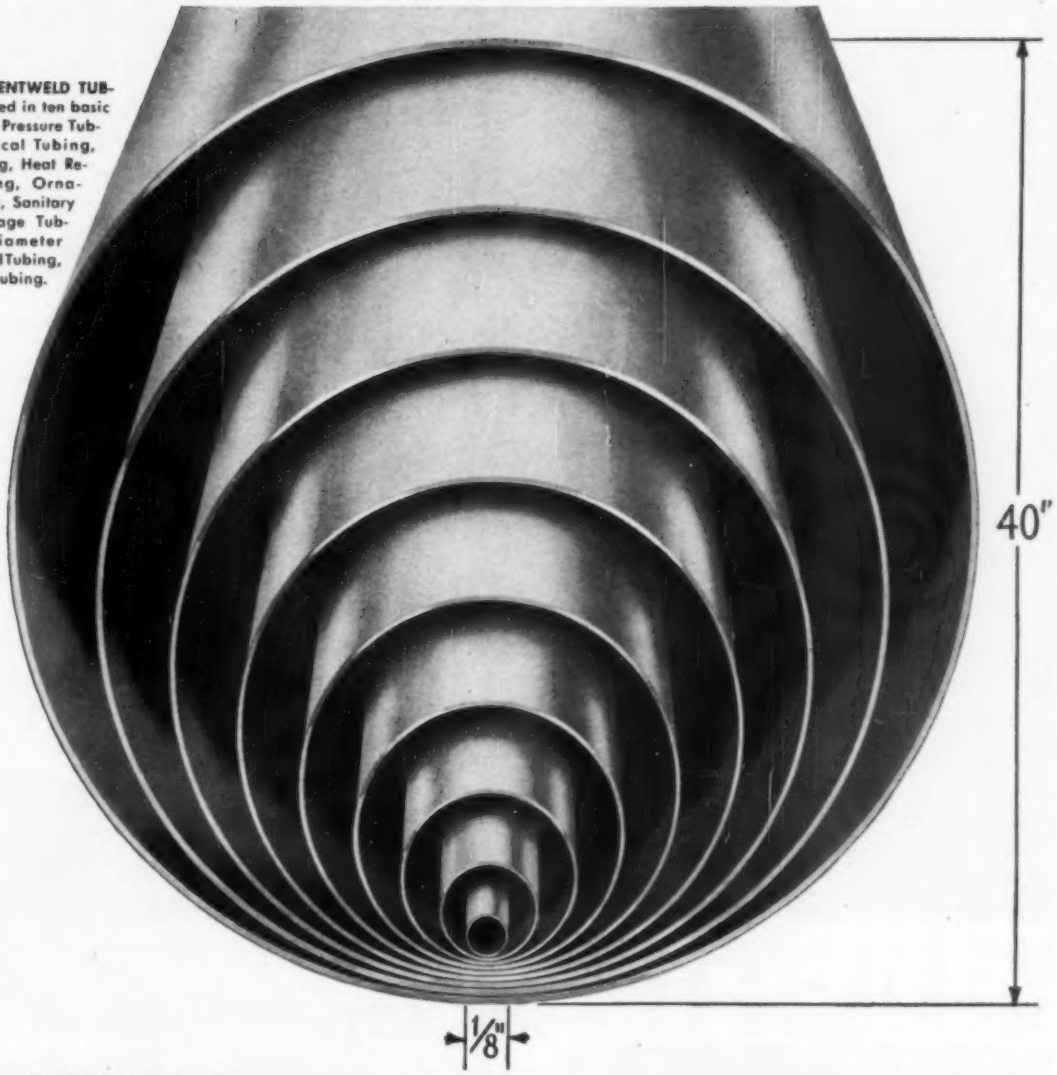
Anti-Icing, Heater & Fuel System Equipment

Engine Accessories


Hi-Temp Manual & Solenoid Operated Valves


Electric Motor Driven Hydraulic Power Packages

CONTOUR TRENTWELD TUBING is furnished in ten basic classifications: Pressure Tubing, Mechanical Tubing, Aircraft Tubing, Heat Resistant Tubing, Ornamental Tubing, Sanitary Tubing, Beverage Tubing, Large Diameter Tubing, Shaped Tubing, and Formed Tubing.



TRENTWELD tubing is equal in strength and has more uniformity than tubing made by any other method of manufacture

Trent offers tubing in sizes ranging from ⅛" to 40" O.D. and in a wide range of grades. These include: Hastelloy,* Zirconium, Zircaloy, Titanium and 18-9-DL grades. All are made by an exclusive welding process—Contour Trentweld®—which virtually eliminates the bead. Furthermore, by cold working and annealing after welding, Trent makes the weld equal in strength and corrosion resistance to the parent metal.

To insure that Trentweld tubing is of the highest quality attainable, a rigorous quality control program is carried out. Samples of each lot are tensile tested. Periodic tests — flattening, reverse bend, flare and flange, coil, and pressure — are conducted. Rigid corrosion tests are made on all lots intended for corrosive applications. When requested, a unique "single-wall" X-ray inspection is made as your final assurance of a sound, uniform product.

Why not take advantage of Trent *quality* when you order stainless or high alloy tubing? For further information, write for the Trent tubing handbook, Trent Tube Company, East Troy, Wisconsin.

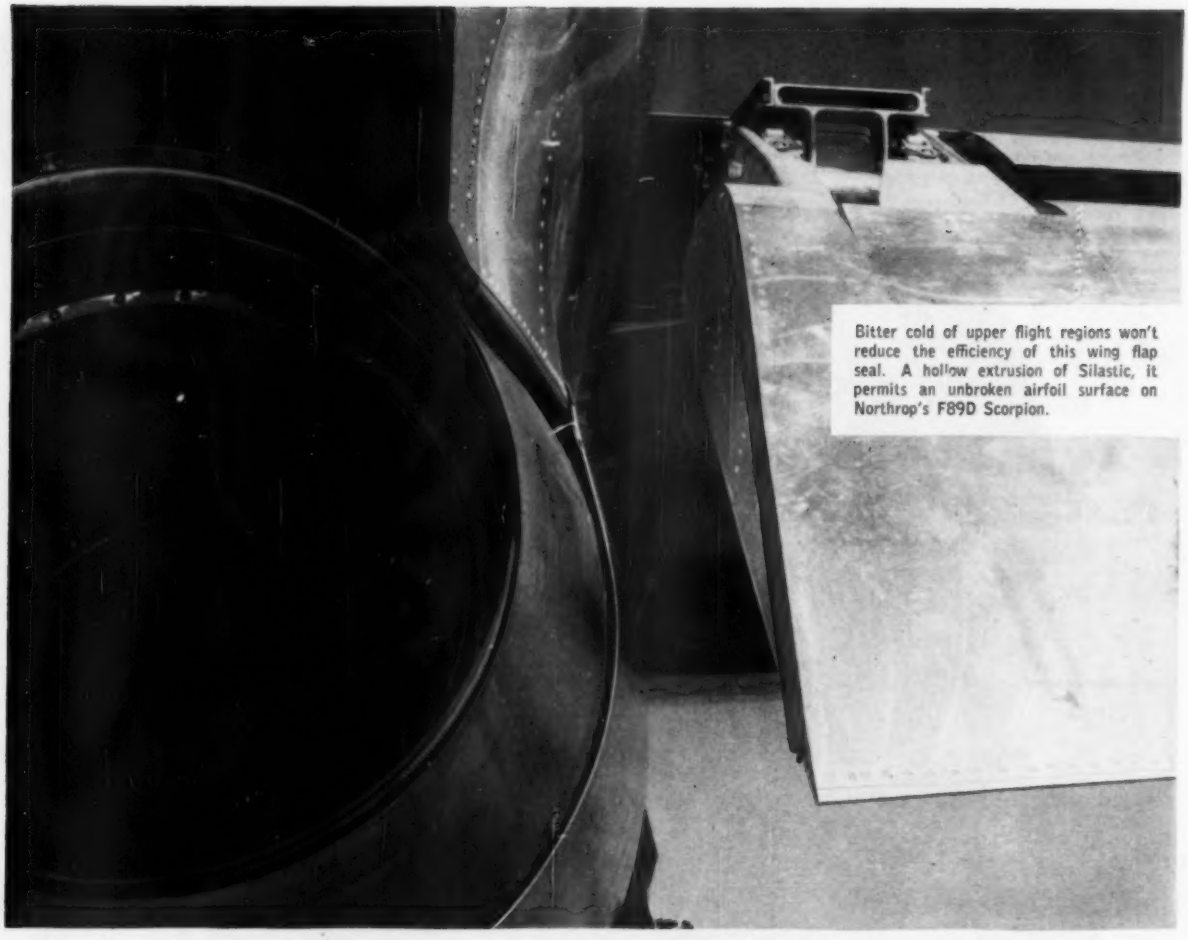
*Trademark of Haynes, Stellite Co.

CONTOUR TRENTWELD

TRENT TUBE COMPANY

Subsidiary of Crucible Steel Company of America

GENERAL OFFICES: EAST TROY, WISCONSIN
MILLS: EAST TROY, WIS.; FULLERTON, CALIF.



Bitter cold of upper flight regions won't reduce the efficiency of this wing flap seal. A hollow extrusion of Silastic, it permits an unbroken airfoil surface on Northrop's F89D Scorpion.

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SILICONE RUBBER

seals stay operational at -130 F

For resistance to fuels, oils and solvents, specify Silastic LS

Extrusions of Silastic*, the Dow Corning silicone rubber, give a firm, resilient seal in spite of extreme temperatures or hot-cold cycling. Silastic seals stay operational from —130 to over 500 F; resist weather, ozone, and compression set. Severe-duty parts of Silastic are available from leading rubber companies in almost any size, shape, or color.

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Typical Properties of Silastic for Seals

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• Elongation, %	150 to 400
• Tear strength, lb/in	120 to 180
• Compression set, %, @ 300 F	25 to 50
• Hardness range, durometer	20 to 80
• Weather, ozone and corona resistance	Excellent

*T. M. REG. U. S. PAT. OFF.

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first in silicones

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fly the polar route...
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On November 10, 1957, a standard twin-engine production model LEARSTAR was flown from PacAero's assembly line in Santa Monica, California, over the Frobisher polar route for delivery in Dusseldorf, Germany. One stop for refueling was made. No special equipment-no auxiliary fuel tanks were carried. This 22 hour, 58 minute polar flight is typical of LEARSTAR safety, performance and ability—approached by no other business aircraft and matched by only three commercial airliners.

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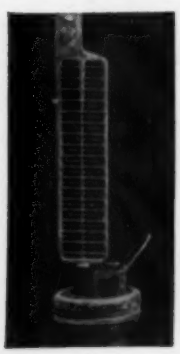
...confidence that you'll be able to take off on schedule

SILVIUM RESISTS CORROSION



Silvium alloy grid after corrosion test.

Non-Silvium alloy grid after same test.

The one time when you can least afford a battery failure is during takeoff. But when you have Exide aircraft batteries in commercial planes, you have dependable protection against the major cause of sudden battery failure.

In place of ordinary positive plate grid alloys, Exide uses Silvium,* a new, patented alloy that resists corrosion up to 100% longer. While in other batteries corrosion often causes sudden failure, Silvium grids normally outlast the battery. In addition, experience proves Silvium stretches battery life, giving you more value for your dollar.

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*U.S. Patent

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- STANDARD POWER AND HAND DRIVERS
- EASY REMOVAL
- 1/16 GRIP VARIATION

Hi-Shear Rivet Tool Company introduces an entirely new, controlled-preload fastener called HI-LOK. Exhaustive tests have proven its reliability and manufacturing facilities are geared for production. The HI-LOK is now available in titanium, type 431 stainless steel, 4130 alloy steel and aluminum. Production sizes range from 3/16″ through 3/8″ with larger sizes to follow.

Write for detailed technical information on HI-LOK and other Hi-Shear fasteners.

*TRADEMARK U.S. and Foreign Patents Applied For

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February 24, 1958

AVIATION WEEK

Vol. 68, No. 8

Editorial Offices

New York 36—330 W. 42nd St., Phone: LOngacre 4-3000 (Nights LO 4-3035)
Washington 4, D. C.—National Press Bldg., Phones: NAtional 8-3414, REpublic 7-6630
Los Angeles 17—1125 West Sixth St., Phone: MAdison 6-9351
Dallas 1—1712 Commerce St., Phone: RIverside 7-5117

European Office—1 rue du Temple, Geneva, Switzerland

PUBLISHER.....Robert W. Martin, Jr.
EDITOR.....Robert B. Hotz

MANAGING EDITOR.....William Gregory
EUROPEAN EDITOR.....David A. Anderton
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A MESSAGE FROM THE PUBLISHER

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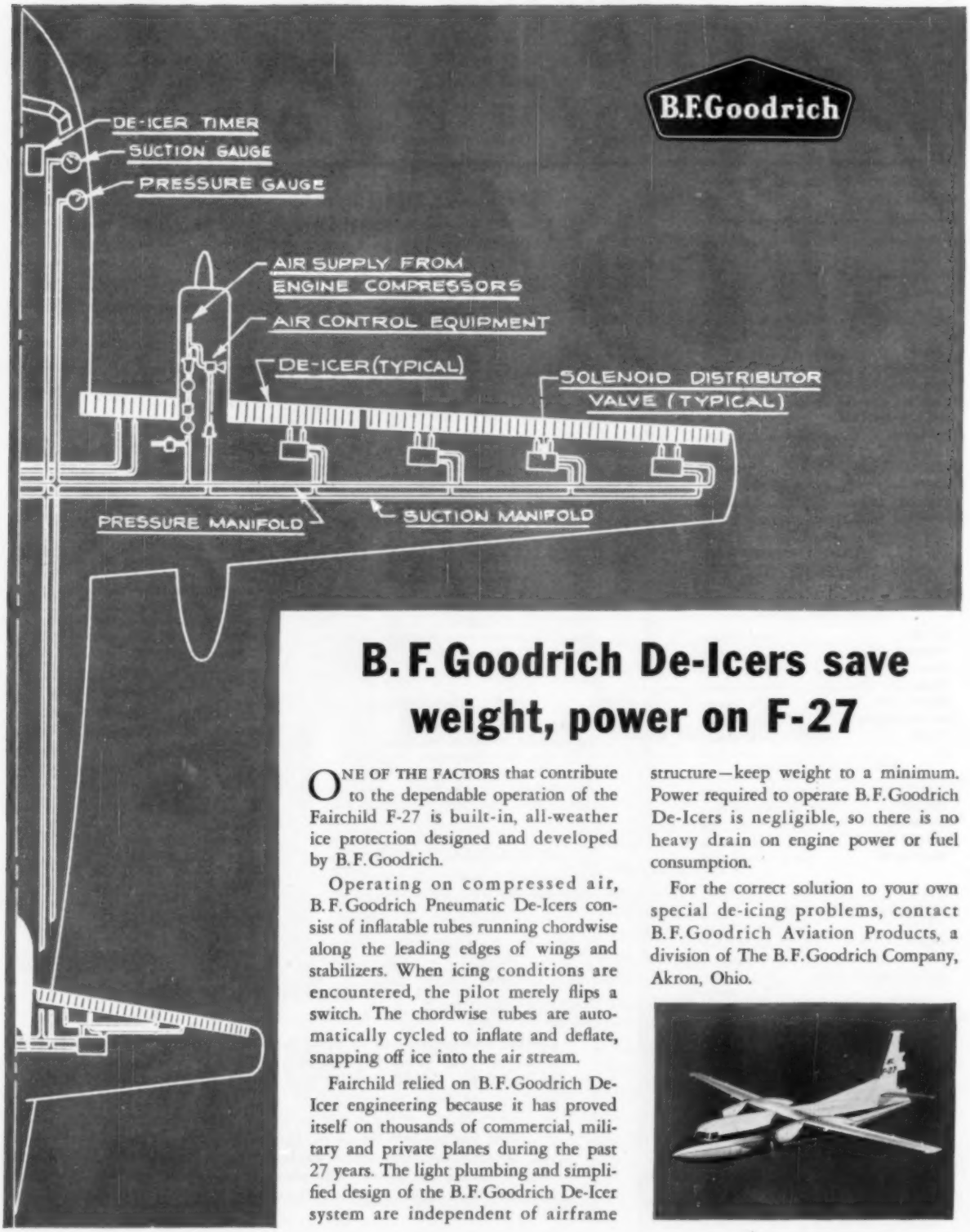
COVER: Last preparations for firing the Convair Atlas ICBM are in progress as the servicing gantry is rolled away from the launching stand at Cape Canaveral, Fla. Missile is being held upright by a Baldwin-Lima-Hamilton weighing and thrust measuring unit. Prior to firing, this equipment keeps an accurate record of the empty weight of the missile and the amount of propellant pumped into the tanks. During the launching, it holds the Atlas and measures the total thrust until the engines reach maximum power. Then it releases the missile. This allows the launching crew to observe the complete thrust build-up and stop the engines if there is malfunction.

Picture Credits:
38, 39—Sovfoto; 59, 97—Wide World.

72,032 copies of this issue printed
AVIATION WEEK • February 24, 1958 • Vol. 68, No. 8
Member ABP and ABC



B. F. Goodrich De-Icers save weight, power on F-27

ONE OF THE FACTORS that contribute to the dependable operation of the Fairchild F-27 is built-in, all-weather ice protection designed and developed by B.F.Goodrich.

Operating on compressed air, B.F.Goodrich Pneumatic De-Icers consist of inflatable tubes running chordwise along the leading edges of wings and stabilizers. When icing conditions are encountered, the pilot merely flips a switch. The chordwise tubes are automatically cycled to inflate and deflate, snapping off ice into the air stream.

Fairchild relied on B.F.Goodrich De-Icer engineering because it has proved itself on thousands of commercial, military and private planes during the past 27 years. The light plumbing and simplified design of the B.F.Goodrich De-Icer system are independent of airframe structure—keep weight to a minimum. Power required to operate B.F.Goodrich De-Icers is negligible, so there is no heavy drain on engine power or fuel consumption.

For the correct solution to your own special de-icing problems, contact B.F.Goodrich Aviation Products, a division of The B.F.Goodrich Company, Akron, Ohio.

B.F.Goodrich aviation products

A Message From the Publisher

Our 1958 Program

This year the aviation industry will face the most challenging problems of its modern history. These problems include a technical revolution of tremendous magnitude as man begins in earnest his exploration of outer space plus complex political and economic issues. AVIATION WEEK's editorial policy has always moved swiftly along the mainstream of the industry's technological expansion.

Therefore, we are establishing with the current issue (see pages 27 and 48) a new major department of space technology headed by Evert Clark, who is widely recognized as an authoritative reporter on this subject. AVIATION WEEK's space technology department will cover the entire spectrum of this burgeoning new area such as basic research, development of space vehicles including missiles, human factors, communications problems, new propulsion methods and all of the other new techniques this field will eventually embrace. In directing this department of space technology Mr. Clark will be supported by the full editorial resources of AVIATION WEEK including 30 graduate engineering and aviation specialist editors. The importance of space technology to the future of this nation and its aviation industry is emphasized by the current concentration on formulating a successful national space policy by the White House, the Pentagon, the National Advisory Committee for Aeronautics, the Congress and the American people. It is becoming increasingly well-recognized that the aviation industry with its related technologies which have already contributed so much in the development of manned aircraft and missiles is the logical platform from which to launch the conquest of space.

As Lt. Gen. Donald L. Putt, USAF Deputy Chief of staff for development, recently pointed out:

"There is no basis for the argument that there is any essential difference between aeronautics and astronautics. The latter is only a part of the larger whole. Aeronautical science embraces the flight of any vehicle that leaves the surface of the earth and goes anywhere by whatever means."

Gen. Thomas D. White, USAF Chief of Staff, further observed:

"The missiles that are getting the headlines today are but one step in the evolution from manned aircraft to piloted spacecraft."

Gen. Orval Cook, president of the Aircraft Industries Assn., has also noted the evolutionary nature of the missile. He said: "Just as we enter the so-called 'missile age' it suddenly appears that it was only a way station; that the next step is to add a man to a missile. Then we give this manned missile another missile to fire at the target and we are back where we started—back to the manned vehicle. All we have done is to provide man with a fantastically increased reach both in space and time."

During 1957 AVIATION WEEK's extensive coverage of space technology, along with all of the other facets of the total aviation picture, made it the most widely quoted technical authority on these subjects in the daily press, both in this country and abroad, in general circulation and management magazines such as the Saturday Evening Post, Business Week, Time, Newsweek and in congressional debates on the defense issue.

This editorial formula attracted an ever-increasing list of top-level industry, military, scientific and legislative subscribers. The net paid Audit Bureau of Circulation figure for December, 1957, was 67,008, with a current figure of 70,000 and a renewal rate of 73%. AVIATION WEEK's subscription price is $7 per year.

This acceptance by the aviation industry resulted in the largest advertising volume ever placed in an aviation magazine.

During 1957 a total of 5,058 pages were run in AVIATION WEEK, representing an increase of 173 pages over the previous record total of 1956.

The aviation industry suffered severely during the economy wave of last summer and early fall but already shows signs of rebounding during 1958. The industry began 1958 with a backlog of $17.5 billion in contracts for military aircraft, missiles, avionic equipment and civil transports. The Fiscal 1959 Defense Department budget submitted to Congress by President Eisenhower last month called for total procurement expenditures on aircraft, missiles and avionic equipment of $10 billion during the fiscal year beginning July 1. New contracting authority requested in this budget totals $10.4 billion in these same categories. These totals already have been boosted by a $1.2 billion supplemental request for Fiscal 1958 rushed to Congress in January with an indication from Defense Secretary Neil H. McElroy that further supplementals may be forthcoming to push high priority defense programs. In addition to these procurement funds, $2.2 billion was requested in research and development funds, the bulk of it for aviation and its related technologies.

During the year ahead, the aviation industry will need both a vigorous voice and a strong public conscience. AVIATION WEEK will continue to do both these jobs without fear or favor and with accuracy as its guiding principle.

—Robert W. Martin, Jr.

Lycoming puts top-flight power in the Vertol 105

Recently a Vertol copter's piston power plant underwent a dramatic conversion: its reciprocating engine was replaced with two compact Lycoming T-53 gas turbine engines.

The result—the Vertol 105, which operates at greater speeds, with greater loading capacity, and with a much lower noise level than the reciprocating engine version.

This conversion is proof to all copter manufacturers that they can install turbine power *without having to design entirely new ships.*

The powerful, economical T-53 is a product of Avco's Lycoming Division and was developed under the sponsorship of the U.S. Army and the U.S. Air Force. Lycoming engines power more different types of fixed and rotary wing aircraft than any other engines in the world.

Avco today—a diversified organization whose products include aircraft power plants and structures, missile research and development, electronics for defense and industry, and specialized home and farm equipment.

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WHO'S WHERE

In the Front Office

Edward J. Hanley, president of Allegheny Ludlum Steel Corp., a director, Westinghouse Air Brake Co., Pittsburgh, Pa.

Paul W. Rhame, a director and assistant to the president, The New York Air Brake Co., New York, N. Y.

Edwin A. Link, president, General Precision Equipment Corp., New York, N. Y.

David A. Mason, president, Link Aviation, Inc., Binghamton, N. Y.

M. A. Chambers, president, National Machine Products Co., Utica, Mich.

E. U. Da Parma, executive vice president, Sperry Gyroscope Co., division of Sperry Rand Corp., New York, N. Y.

Honors and Elections

Dr. Louis N. Ridenour, head of research for Lockheed Missile Systems Division, has been appointed to the Air Force's Scientific Advisory Board, and **Dr. Frank C. Hoyt,** manager of the physics division of Lockheed Missile Systems Division, has been named to the Atomic Energy Commission's Committee of Senior Reviewers.

James S. Arnold, Stanford Research Institute physicist, has been elected vice president of the Northern California Section of the American Rocket Society for 1958.

Dr. Karl Arnstein has been awarded the Navy Distinguished Public Service Award, the highest honor which the Navy can grant to a civilian, for his outstanding contribution to the Navy Department in the fields of scientific research and development. Dr. Arnstein retired in 1957 as vice president in charge of engineering for Goodyear Aircraft Corp.

Col. Bernt Balchen (USAF, ret.), has been elected a member of the board of governors of the Flight Safety Foundation, Inc., New York, N. Y.

Princeton University has officially named the headquarters building for the aeronautical sciences at the James Forrestal Research Center, Sayre Hall, in honor of the late Daniel Clemens Sayre, aviation pioneer.

James Martin, chief designer and managing director of Martin-Baker Aircraft, has been awarded the Laura Taber Barbour Air Safety Award by the Flight Safety Foundation, Inc. Mr. Martin, the first Briton to receive the award, was honored "for his outstanding contribution to the safety of crews of high performance aircraft through the design and development of ejection seats."

Changes

Robert A. Barker, manager of engineering, Wire and Cable Division, The Electric Auto-Lite Co., Toledo, Ohio.

Earl L. Fester, general manager, and **Davis Spencer,** sales manager, Miehle-Dexter Supercharger Division, The Christensen Machine Co., Racine, Wisc.

Maj. Gen. Samuel R. Harris, (USAF, ret.), assistant executive manager, Lytle Engineering & Mfg. Co., Chicago, Ill. Gen. Harris' headquarters will be at the Albuquerque, N. M., division.

INDUSTRY OBSERVER

► Air Research and Development Command's Ballistic Missile Division has put development of solid propellant engines for intercontinental ballistic missiles on a crash basis.

► **Air Force is considering Bendix proposal for a Mach 2 liquid propellant rocket-powered target drone that also would be fitted with anti-missile missile jamming equipment. Known as Project Penny, drone would have relatively low cost. It would be launched from a mother plane and be non-recoverable.**

► Rover nuclear-powered rocket engine to be fired later this year was designed and developed by AEC-University of California Los Alamos and Livermore Laboratories. Test will be carried out at AEC's Watertown, Nev., facility.

► **Sperry will do research and development of AN/FPS-35 3,000-mi. missile detection and tracking radar. Purpose is to develop an integrated system combining in one piece of equipment and one antenna a missile detection and missile tracking capability. Radar set will use coherent integration receiving technique, very high power transmitter and combined function antenna. Sperry, which has $21 million letter contract, probably will do extensive subcontracting.**

► Air Force has a high priority project to explode a nuclear device at very high altitude as part of Operation Hardtack at Atomic Energy Commission's Eniwetok test grounds. Army plans similar firings during the operation, using its Redstone missile (AW Jan. 20, p. 26).

► **Convair B-58 supersonic bomber has a new pod configuration in which fuel section can be dropped while aircraft retains nuclear or thermonuclear portion of the weapon. Drop would be made in event the bomber is intercepted en route to target. Flight test of the new two-section unit already has been conducted.**

► Soviet Union's present submarine fleet has an estimated four vessels equipped with 500-mile-range missiles roughly comparable to Chance Vought's subsonic Regulus I. Russia recently slowed its submarine production and apparently is retooling and training its technicians to begin manufacture of long-range nuclear subs.

► **Tentative schedule for North American Aviation's F-108 long-range interceptor contemplates production of two aircraft in 1960, six in 1961 and seven or more in 1962.**

► Italy hopes Sardinia will be chosen as the base for NATO's intermediate ballistic missile test range since France's Colomb Bechar range in the Sahara is out of the question because of the unstable North African political situation.

► **Texas Instruments is testing its photographic mapping radar system with RB-66 bailed from Air Force. Flight tests of the new sidelooking radar system are made from Dallas' Love Field. Results thus far reportedly have been good.**

► Production Fairey Fireflash air-to-air missiles have cordite-filled rocket motors designed by the airframe manufacturer featuring improvements over early government-furnished motors. New motors have cut missile's weight by 10%-15%. Fairey sends motor components to a government operated facility for loading.

► **Kaman Aircraft has received an order for 130 of its H-43 four-bladed single main rotor and tail rotor helicopter from Strategic Air Command. Two helicopters will be stationed at each SAC base.**

► About 13,000 Sidewinder infrared-guided air-to-air missiles for USAF and Navy are included in orders thus far. Approximately 16,000 Nike Ajax ground-to-air missiles have been built to date.

•••••MISSILE GUIDANCE SYSTEMS•••••••

Projects of H. T. Budenbom,
Senior Scientist, Stavid Engineering, Inc.

Included in Mr. Budenbom's 25 patents and numerous technical papers are his original contributions in monopulse development and authorship of many new concepts in the application of electronics to modern warfare. His experience and inventive talents are being applied to Stavid's projects in weapon systems development and missile electronics. Mr. Budenbom is one of a group of outstanding scientists and engineers at Stavid who are working on advanced concepts . . . years ahead of actual systems development.

In Stavid's objective engineering atmosphere, scientific, development and manufacturing teams are producing a wide range of electronic systems for all branches of the military. A typical project calls for development of the high power Radar Set AN/SPS-31.

OTHER STAVID PROJECTS INCLUDE:

- Anti-Missile Systems
- Airborne Search, Bombing and Terrain Clearance Radar
- Missile Tracking Beacons
- LANCE Weapon System
- Radar-Infrared Airborne Fire Control System
- Automatic Missile Checkout Systems

STAVID Engineering, Inc. Plainfield, New Jersey

Imaginative Electronics . . .

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Washington Roundup

Killian 'Unexpediter?'

Joint Congressional Atomic Energy Committee has scheduled Feb. 26 for a showdown with the Administration over the future of the nuclear-powered aircraft program. The already much-studied program is now being studied by Dr. James Killian, Presidential science adviser.

The committee wants Air Force to be given the "go ahead" on a "crash" program aimed at having an aircraft flying within two years. Rep. Melvin Price (D.-Ill.), chairman of the research and development subcommittee, emphasizes the psychological as well as the military importance to the U.S. of being first with the atomic plane. He vigorously opposed a move by Navy in January to withhold action on the proposed USAF program while an alternative Navy program might be considered (AW Jan. 13, p. 33). "This project to produce a nuclear airplane has almost literally been studied to death over the years of its existence," Price declared. "What the program needs is action, not another study group. . . ."

The Atomic Energy Subcommittee, however, gave Deputy Defense Secretary Donald A. Quarles until last Monday to make a final decision on the program. Price reports that Quarles reported he could not produce a decision since the program had been turned over to Dr. Killian for study. "Dr. Killian was brought in to be an expediter," Price remarked. "He has turned out to be an 'unexpediter.'"

Meteorology Research

Commerce Department plans to expand its meteorological research program. Commerce Secretary Sinclair Weeks is asking Congress for legislation authorizing the department to enter into contracts with private research institutions. At present, the department can only enter into such contracts if the research is directly related to the safety and efficiency of air navigation.

"If the department were to attempt to perform all meteorological research at its own facilities with its own personnel, substantial temporary increases in both facilities and personnel would be required." Weeks wrote Sen. Warren Magnuson (D.-Wash)., chairman of the Senate Commerce Committee. "Research contracts make available the desired facilities and experienced personnel at far less cost to the government."

CAB Ethics . . .

Investigation of the House Subcommittee on Legislative Oversight into federal regulatory agencies is giving impetus to legislation defining relationships between industry and Civil Aeronautics Board and other regulatory agencies. A measure introduced last week in the Senate by Sen. William Proxmire (D.-Wis.) and in the House by Rep. Morgan Moulder (D.-Mo.) would ban gifts or gratuities to members of regulatory agencies.

Seven senators promptly volunteered to co-sponsor the Proxmire bill—Strom Thurmond (D.-S.C.), William Langer (R.-N.D.), Hubert Humphrey (D.-Minn.), Lister Hill (D.-Ala.), Clinton Anderson (D.-N.M.), John Sparkman (D.-Ala.) and Wayne Morse (D.-Ore.).

Legislation introduced by Sen. Henry Jackson (D.-Wash.), setting criminal penalties for officials of regulatory agencies who make unauthorized leaks of information and members of industry who use pressure on regulatory officials is already pending.

. . . Schwartz and National

However, the slow rate of progress being made by the House Subcommittee on Legislative Oversight is an indication that any investigation of the Civil Aeronautics Board may be a long way off, if it comes about at all.

Witnesses testifying in the Federal Communications Commission award of television channel 10 in Miami to National Airlines are being questioned to great length by subcommittee members and many new names of persons allegedly involved in the case have been suggested as future witnesses.

Some observers at the hearings believe that the line of questioning has not been organized to shed any "real light" upon accusations made by ousted counsel Bernard Schwartz. Schwartz told the subcommittee that he had gathered leads on possible outside intervention in CAB cases which should be investigated by thorough questioning of the persons involved. Among the names mentioned were Presidential Assistant Sherman Adams.

Snow Lift

Post Office Department has turned to the commercial airlines for help in breaking the heavy backlogs of first-class three-cent mail that accumulated in areas suffering from a shortage of surface transportation as a result of last week's storms that blanketed the eastern portion of the U.S. with deep snows. Large volumes of mail were diverted from railroads to the air carriers in Boston and other New England centers for movement to Pittsburgh, Chicago, Washington and points in Florida. Mails trapped in New York by lack of surface transportation were flown to Washington, Pittsburgh and points west.

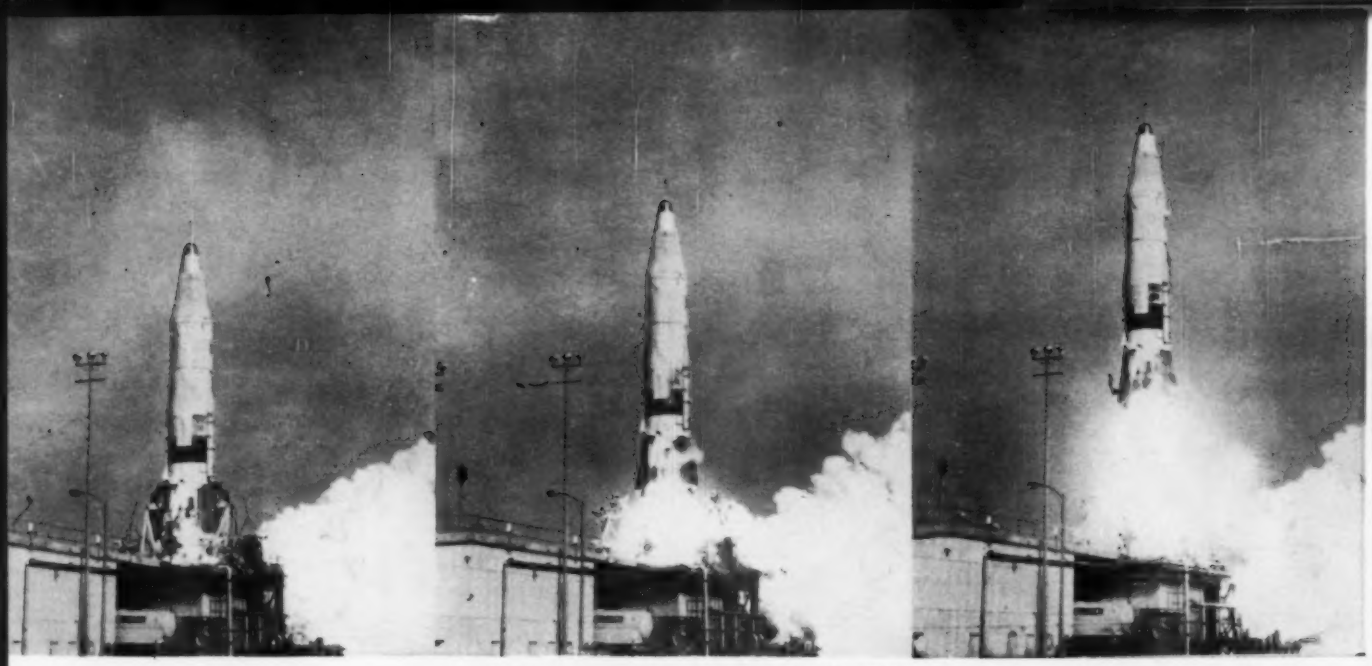
Coast Guard Aviation

Coast Guard has a five-year $95.4 million program to build its air fleet from a total 128 to 195 aircraft. It involves a $9 million program for Fiscal 1959 for replacing over-age aircraft, and an annual $21.6 million program for the next four years. CG plans to buy Martin P5M Marlin seaplanes, Lockheed C-130 Hercules landplanes, Grumman UF Albatross amphibians, Sikorsky HUS medium helicopters, and Bell HUL light helicopters.

False Security Spread

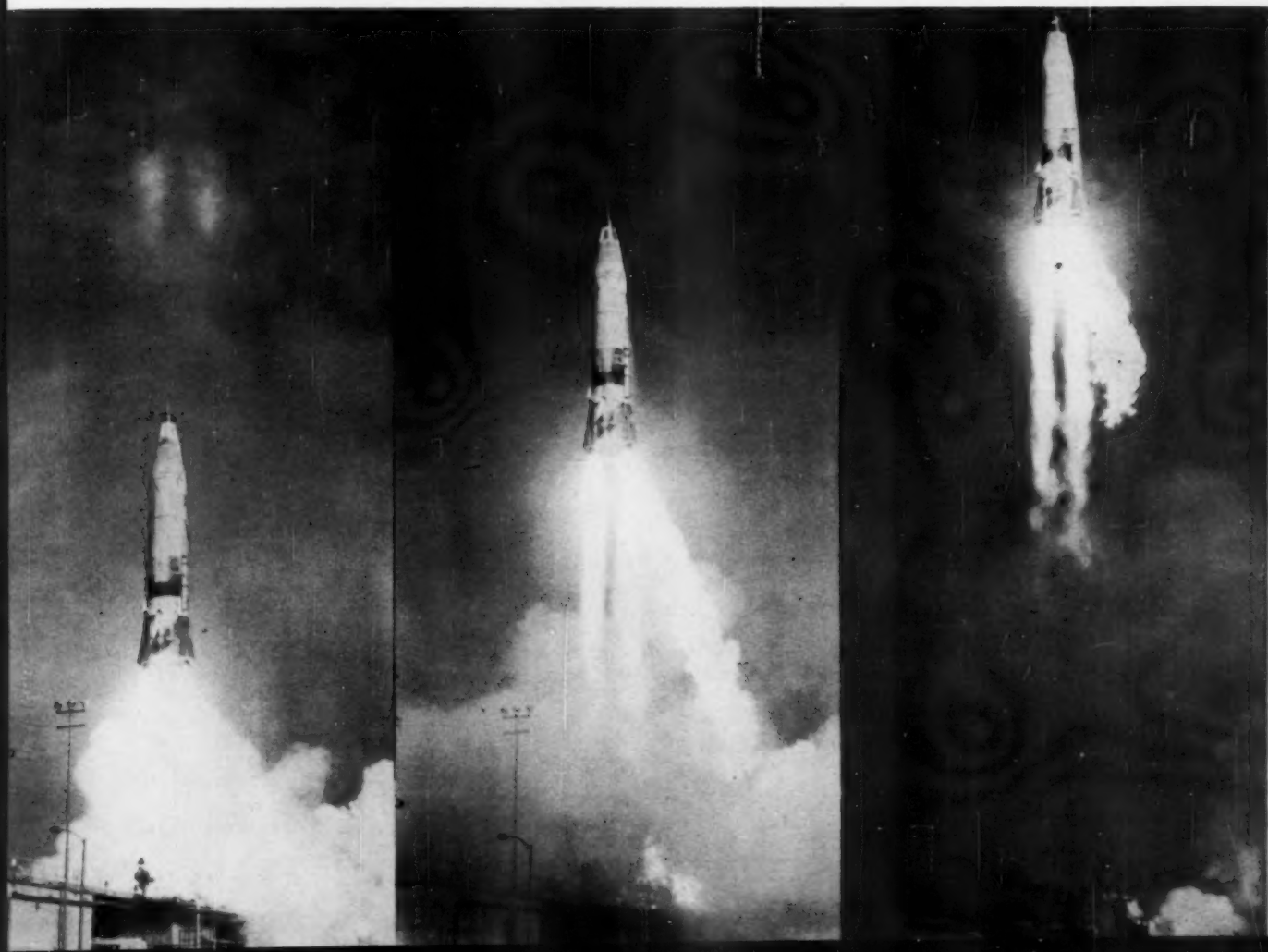
False security apparently is also a problem in Europe. German Defense Ministry has clamped a strong security screen around the country's latest military aircraft being rolled out of the Lemwerder plant of Weser Flugzeugbau and forbids factory visits except by cleared officials. Meanwhile, the long lines of parked aircraft behind the factory are being photographed frequently from Russian freighters cruising slowly down the river adjacent to the company's airfield. The secret airplanes: Republic F-84Fs and RF-84Fs, built in the U.S. under a 1953 contract and long since described in accurate detail by the technical aviation press of European countries as well as by AVIATION WEEK.

—Washington staff



Atlas Thrust Is Measured on Pad

Booster engines on the Convair Atlas ICBM are run at full power momentarily before the missile is released during firing at Patrick AFB, Fla., (left photo above). Unit which is restraining the missile and measuring the thrust is built by Baldwin-Lima-Hamilton Corp. It records the complete thrust build-up and if the engines are not operating properly the launching can be stopped (AW Apr. 8, 1957, p. 50). Atlas is released in center picture and then rises in photo sequence. This was not a maximum takeoff weight test as the sustainer engine was not installed. Gas generator is source of irregular plume (below, right).



Space Technology

USAF Studies High-Thrust Space Engine

By Evert Clark

Washington—USAF has initiated development of a single-chamber rocket engine that would produce 1,000,000 lb. of thrust and another whose units could be manifolded together to produce more than 1,500,000 lb. for use with future space vehicles.

Richard E. Horner, USAF Assistant Secretary for Research and Development, told the House Armed Services Committee last week that studies leading to an engine that could be clustered to produce 1,500,000 lb. were initiated in 1954.

"This engine was put under active development almost two years ago," Horner said. "Although we have still not identified a specific application for it, we are certain that it will be needed for many astronautics applications. . ."

Development of the single-chamber, 1,000,000 lb. thrust engine was initiated "somewhat more recently," Horner said.

"Here again, we have no specific application, but it is certain that this is the next logical step in a program to assure our future technical superiority in space."

Horner said these examples illustrate the fundamental research and development principle that "we must support a broad technical program that establishes a sound foundation of scientific knowledge upon which we can build superior components and techniques for the weapon systems of the future.

High Risk Approach

"We cannot be inhibited by our lack of imagination in foreseeing exactly the application for each element of the program." At the same time, USAF must "exercise a high degree of selectivity," improving management and selecting the most productive lines of development, Horner said.

"In this respect, it is important to be critical of the conservative approach, as well as the high risk approach, that might waste our dollars in an effort that cannot prove fruitful," Horner said.

"In general, the effort to make a big advancement always involves a relatively large risk.

"We cannot be too fearful of failure, for a research and development program that attempts only the sure thing is sterile and productive of only a small or short-term gain.

"The stakes that are involved in the current technological competition certainly warrant—indeed they demand—that we reach for the largest possible advantage from technological advance, accepting occasional failure as necessary and recognizing fruitless lines of development as early as they can be identified."

This is perhaps the strongest statement regarding the question of taking a bold approach and running technical risks that any Air Force leader has made since the launching of Sputnik I.

Concept of doing research or developing hardware for which no specific requirement exists has never been popular either within the services, the Defense Department or on Capitol Hill—chiefly because specific requirements always compete with such projects for limited appropriations dollars.

While USAF has been conducting research leading toward space flight for years, such programs have had to fight hard for survival even within the Air Force, and many have not been successful.

Curtailment 'Chaos'

Sputnik launchings, in fact, came in the midst of severe curtailing of the very kind of research and development programs Horner discussed. He took note of the effect of this in his testimony before the committee.

Horner pointed out that USAF has more than 5,000 active R&D contracts with some 170 educational and nonprofit institutions and more than 1,700 industrial organizations.

"In an effort of this scope and magnitude, the chaos that is created by marked changes in the level of support can scarcely be imagined," Horner said. "Even though the progress that we have made in the last 10 years has been truly remarkable, I am sure that its expense has been greatly increased by the seemingly constant fluctuation in resources that are available for its instrumentation.

"Since the end of World War II this nation has gone through several cycles of relative complacency. This has been reflected in reduced support and resultant retardation of the research and development program on the one hand, and urgent expansion—usually as the result of Soviet actions—on the other.

"This stop and go process is extremely wasteful of dollar resources, time and technical manpower. I am sure that no one could be closely associated with the management of research and development without realizing the urgency of eliminating such uncertainty."

Navaho Contribution

As an example of the need for an application to justify development work, Horner cited the now-canceled North American Navaho air-breathing intercontinental missile, which he called "anything but an unqualified failure.

"For a period of several years, the continued development of large liquid rocket engines was justified almost solely on the needs of the Navaho," he said. "Furthermore there were marked advances in inertial guidance, aerodynamics and high temperature materials that resulted from this program.

"It is entirely accurate to say that without this work, many of our current weapon systems would not be as far advanced as they are."

Another example is the liquid rocket engine work initiated by USAF after studies began in 1946, even though no specific application existed. These engines now power Atlas, Titan, Thor, Jupiter and Redstone missiles.

"This is an excellent example of the necessity for fostering advance developments in many areas prior to their commitment to specific weapon system applications," Horner said.

Soviets Warn of Circumlunar Difficulty

Moscow—Russian public, enthused over the success of Sputniks I and II, is being warned not to become overly optimistic over the possibility of an early Soviet launching of a circumlunar vehicle.

Professor V. Sharonov, writing in the government newspaper Izvestia, warns that "the task of orbiting an artificial satellite around the Moon is very far from the practical capabilities now available to us."

Sharonov said the main problem is the need to boost a satellite's speed from the present 10 kilometers per second to 12 kilometers per second rather than distance—384,000 kilometers as compared with the 1,700 kilometer apogee of Sputnik II. He added:

"Achieving this two-kilometer-per-second speed increase is a far from simple job."

Sharonov also said that manned flight to the Moon will not be accomplished within the near future.

More Missile Submarines Asked To Combat Soviet ICBM Threat

By Ford Eastman

Washington—Rep. Clarence Cannon (D.-Mo.) renewed his plea last week for construction of more nuclear-powered missile submarines to replace the subsonic bombers of Strategic Air Command when they become obsolete.

Rep. Cannon, chairman of the powerful House Appropriations Committee, said in a floor speech that the U.S. faces its greatest threat after Soviet intercontinental ballistic missiles become operational and before those of the U.S. are perfected. It is only a matter of time, he said, before the Soviet Union will have neutralized SAC, and the U.S. will be without retaliatory power except for missile submarines. He added that a concerted attack might give the Kremlin control of the world in a week.

First of Navy's Polaris missile submarines is scheduled to become operational in October, 1960; Soviet ICBMs in December, 1959.

Referring to a report by Adm. Arleigh Burke, chief of naval operations, Cannon said a possible method of attack by the Russians might be the use of missile-launching ships disguised as merchant vessels that could hit any city within 550 mi. of the coast. He added that 43 out of 50 of the largest cities and 85% of U. S. industry are situated less than 500 mi. from the coast.

Power Decline

Cannon said the U.S. was the greatest military power the world has ever seen at the end of World War II but that its power has declined in the last few years. The rate of Russian expansion has been unprecedented, he said, not only in war potential and armament but in the production of capital goods and industry.

"The expansion of the Red army has been amazing," Cannon said. "Russia now has 175 divisions and the unquestioned capability of mobilizing a total of approximately 300 divisions in 30 days. The United States will maintain in the next fiscal year 14 divisions with three Marine divisions."

The Appropriation Committee chairman added that Russia has out-produced the U.S. in new submarine tonnage by six to one; in destroyer tonnage by nine to one and in cruiser tonnage by 14 to one.

He pointed out that, although the Soviets have not built a single carrier, it has the greatest submarine fleet the world has ever seen and is building aircraft faster than any other nation.

Cannon on U. S. Lag

"We are behind the Russians in the following areas," Cannon said:

- **Race for outer space.**
- **Intercontinental ballistic missiles.**
- **Submarines.**
- **"In Army and Army rifles** and tanks."
- **"In ocean survey and exploration**—in oceanography. They are using 30 hydrographic ships, and we are employing eight."
- **Radar.** "They have about 10 times as much as we have, and it is more effective against high flying bombers."
- **Production of aircraft** and missiles.
- **Development of rocket fuels.**

Cannon added: "We are ahead of the Russians in supercarriers, tomahawks and scalping knives."

"The power and speed of modern weapons have destroyed forever America's geographic invulnerability," he added. "The ocean, instead of being an asset, is now a liability—a jungle in which the predatory tiger of the sea, the killer submarine, lurks. . . ."

He said the U.S. has met the situation thus far with SAC B-52s—long range bombers armed with nuclear warheads.

Cannon said there are about 160 North American Treaty Organization airfields and 250 national airfields dispersed in Western Europe where SAC can strike any military objective in Russia in comparatively few minutes.

"The Russians are now building a new air defense system, using improved radar and anti-aircraft missiles with nuclear warheads with which they expect to block the SAC bombers at the border," he said.

"It is claimed," he added, "that very shortly the Soviet defense will be made so effective that the first 100 B-52s or B-47s striking at Moscow would be shot down before reaching the target. In other words, within a year it may take 100 planes to land one bomb. When this will have been effected, SAC will be relegated to the limbo of the past along with the cavalry, the supercarrier and the blunderbuss."

The Navy report visualizes a possible attack by missile-launching ships disguised as merchant vessels, Cannon said, which would be more difficult to recognize than one by missile-launching submarines.

"If each merchant vessel carried six missiles and launched them within one hour, 12 ships could be used to replace 35 submarines required for a submarine attack," he said. "There would be under normal conditions about 75 unidentified ships within 500 miles of the coast at any given time, and, quoting the Navy report, if our only means of recognizing a raid consisted of assigning aircraft to track each unidentified ship until it unmasks to launch missiles or moves out beyond the assumed missile range, prohibitive numbers of aircraft would be required for the surveillance effort, even for short warning times."

As for the use of missile submarines in an attack on the U.S., Cannon said that no reasonable amount of anti-submarine effort can prevent immense damage. He said that, on the Atlantic coast, it is expected that six out of 15 submarines could be destroyed, while only one out of five could be sunk in a West Coast raid.

Cannon said 105 Soviet submarines could damage up to 65% of all parked SAC aircraft in the U.S.

Cannon charged that the U.S. would not be in "deadly peril" today if the Navy had not insisted on big appropriations for "big ships for big admirals" when the money, time and attention should have been given to the development of American aircraft, submarines and missiles.

Tupolev: Supreme Soviet

Moscow—A. N. Tupolev and V. M. Myasishchev, two of the Soviet Union's leading aircraft designers, have been nominated as deputies of the Supreme Soviet in the forthcoming national election. Nomination to the Supreme Soviet, Russia's highest legislative body, is tantamount to election.

USAF Promotions

Washington—Four Air Research and Development Command officers have been nominated for temporary promotion from brigadier to major general. They are:

- **Brig. Gen. Stanley T. Wray, commander, Wright Air Development Center.**
- **Brig. Gen. Victor R. Haugen, assistant deputy commander for weapon systems.**
- **Brig. Gen. Don R. Ostrander, deputy commander for resources.**
- **Brig. Gen. Marvin C. Demler, deputy commander for research and development.**

Those nominated by President Eisenhower for promotion to major general also include Brig. Gen. Charles M. McCorkle, USAF assistant chief of staff for guided missiles, and Brig. Gen. Ben I. Funk, deputy director of ballistic missiles, Air Materiel Command.

Rocketdyne Gets Atom Engine Contract

Washington—Nuclear rocket engine research and study contract has been awarded to Rocketdyne Division of North American Aviation Inc. by Air Force.

Contract is being administered by Wright Air Development Center of Air Research and Development Command, and Atomic Energy Commission.

North American has been doing experimental research studies on nuclear engines since 1946.

AEC is expected to ask Congress soon for more funds to accelerate nuclear rocket work (AW Feb. 17, p. 29). Its Rover nuclear rocket engine is scheduled for test firing later this year.

Rocketdyne, with main offices in Canoga, Calif., has just opened the Rocketdyne Research Center at its Propulsion Field Laboratory in the Santa Susana Mountains. Facilities include a petroleum fuels laboratory which the company said is "believed to be the equal of any similar laboratory on the West Coast, including those of major oil producers," and a helium cryostat. New center together with chemistry and metallurgy laboratories in Canoga Park employ some 270 research personnel.

North American also has named an eight-man team to head Astrodyne, Inc., formed last month in McGregor, Tex., under equal ownership by NAA and Phillips Petroleum Co. Astrodyne will do research, development and manufacture of high energy solid fuel and solid propellant rocket engines.

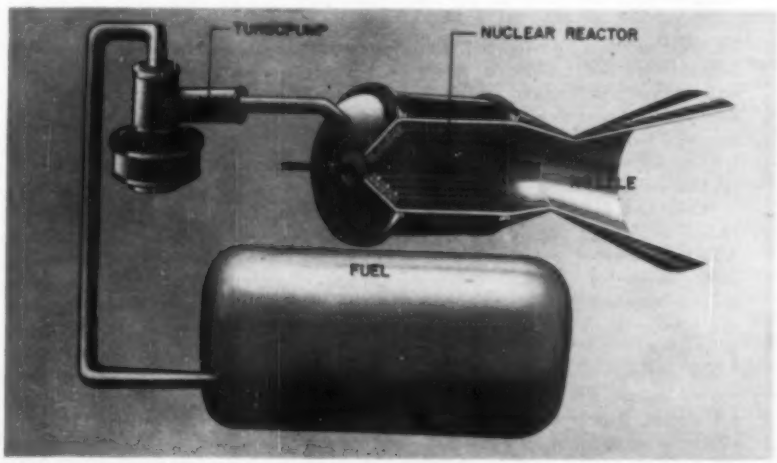
John F. Tormey, former director of research for Rocketdyne, will head development and engineering. Richard J. Martinelli, former assistant manager of manufacturing in Phillips' rocket fuels division at McGregor, will head manufacturing.

R. L. Storer, former quality control manager for Phillips, will do the same job for Astrodyne. George F. Emerich, former group leader on solid propellants for Rocketdyne, will be Astrodyne's plant engineer.

L. A. Maciula, former assistant plant manager at McGregor, will direct personnel and administration. Contracts and proposals department will be headed by Kenneth P. Johnson, who held the same job with NAA's Fresno Division.

Richard K. Moore, former public relations chief at Fresno, will direct public relations, and Paul J. Fritch, former chief accountant of Phillips Atomic Energy Division at Idaho Falls, Idaho, will be controller. Vice president and assistant general manager of Astrodyne is Thomas E. Myers, former manager of plant engineering at Rocketdyne.

NUCLEAR engine pushes this missile toward Moon in Rocketdyne artist's conception of space flight. First test firing is scheduled for later this year at Nevada proving ground.



REACTOR located in combustion chamber in this schematic drawing would provide energy to convert fluid to ultra-high temperature gases which would expand. Using working fluids such as ammonia, helium or hydrogen, the nuclear rocket may achieve specific impulses of 400 to 900 sec., according to one Rocketdyne spokesman.

Powerplant, Navigation Progress Help Trim Timetable for Polaris

Washington—Breakthroughs that have permitted Navy to cut its timetable for operational introduction of the Polaris fleet ballistic missile by three years to the present date of October, 1960, have been in areas where most trouble was expected.

Major progress has been made during the past year in both thrust determination and vector control, traditionally big problems in solid propellants.

Navy also is approximately a year-and-a-half to two years ahead of schedule in solving the navigation problems associated with firing an intermediate range ballistic missile from sea.

Heart of the navigation system for Polaris submarines will be the Ship's Inertial Navigation System (SINS) credited primarily to Dr. Stark Draper of Massachusetts Institute of Technology. The system will give at any one time the latitude, longitude, local vertical and precision azimuth.

Navy, with $350 million made available through supplemental Fiscal 1958 budget appropriations, has ordered three of the Polaris submarines into production—two to be built by the Electric Boat Division of General Dynamics Corp., Groton, Conn., the third by the Mare Island Naval Shipyard, Vallejo, Calif. The submarines, which probably will be the world's largest, will each carry 16 of the 47-ft.-long Polaris missiles.

Weight of each submarine will be 5,600 tons. Polaris weighs about 28,000 lb.

To lessen chances of crew injury and ship damage, main power units of the Polaris will not cut in until after the missile has been launched from the submarine at a probable depth of 100 ft.

Missiles will be stored and fired vertically, leaving the submarine through wells in the forward deck.

Navy Secretary Thomas S. Gates, Jr., has said that an additional six submarines can be built within the same time limit, or sooner, if the Defense Department and Congress approve a request for an additional $1 billion.

In development of the missile itself, specified increases in the specific impulse of the solid-propellant powerplant have been met on schedule by the contractor, Aerojet-General Corp.

Good progress also has been made in experiment planning and experiment design and in improving the methods for environmental ground tests.

Navy, in the fast development of the Polaris, given a top national priority only this month, drew heavily upon previous solid propellant work by both Air Force and Army. The missile also incorporates the blunt nose cone developed by National Advisory Committee for Aeronautics.

Navy is still working to refine the missile, including a lighter case and lighter warhead to obtain more range. It also hopes to improve its reaction time and reliability.

USAF Plans to Study Moon Surface

Washington—Comprehensive planning for rocket projectile program aimed at gathering data on Moon's surface material characteristics has been essentially completed by Rand Corp., Air Force planning and research agency.

Known as Project Lunatic—Lunar Test Instrument Carrier—the Rand program contemplates use of USAF's Convair Atlas intercontinental range ballistic missile as initial booster stage for the multi-stage rocket projectile. It would have a pointed nose to facilitate penetration of the Moon's surface.

Information fed back by the projectile's instrumented nose cone would be invaluable in any future attempt to establish a lunar base with extensive facilities for both military potential and scientific exploration of space beyond the Moon. Scientists are not completely agreed on the composition of the Moon's surface material and distribution. After untold years of meteoric bombardment, rock dust and fragment deposits on the lunar "plains" may extend from a few inches to several miles in depth.

Some knowledge of this depth and related surface characteristics would facilitate establishment of a lunar base.

While first impact on the Moon probably will be made with a Douglas Thor IRBM as booster because of its development readiness (AW Jan. 20, p. 26), Atlas was selected for the booster stage in the Rand Moon rocket projectile study because of the large combined payload of instrumentation, guidance and controls required for precision impacting of nose cone at predetermined speed and angle. Knowledge of these two factors will be essential in calculation of penetration.

For accomplishment of proper trajectory, Atlas' burning-phase guidance would control nozzle position for angularity and speed at cutoff to within one foot per second, it is reported. As the Moon is approached, retrorockets will be activated for slow-down to calculated entry speed, which will be low enough to avoid destruction of instrumentation on impact. Rockets also would be gimbal-controlled to insure proper entry angle.

Transmitting and receiving equipment now in being could be modified to fit the long-range communication requirements.

NACA Space Group Holds First Meeting

Washington – Space Technology Committee of the National Advisory Committee for Aeronautics has held its first meeting and created working groups to help NACA focus its efforts on problems of flight beyond the atmosphere. Groups and their chairmen are:

- **Objectives**—Dr. James A. Van Allen, Department of Physics, State University of Iowa.
- **Vehicles**—Dr. Wernher von Braun, director, Development Operations Division, Army Ballistic Missile Agency.
- **Re-entry—Dr. Milton U. Clauser,** director, Aeronautical Laboratory, Ramo-Wooldridge Corp.
- **Range, launch and tracking**—James R. Dempsey, manager, Astronautics Division of General Dynamics Corp.
- **Instrumentation, communication and navigation**—Dr. William H. Pickering, director, Jet Propulsion Laboratory, California Institute of Technology.
- **Space surveillance**—Dr. Hendrik W. Bode, director, Mathematical Research, Bell Telephone Laboratories.
- **Human factors and training**—Dr. W. Randolph Lovelace II, Lovelace Clinic, Foundation for Medical Education and Research.

New members of the committee since AVIATION WEEK reported its membership on Feb. 3 (page 33) are:

- **Col. Norman C. Appold,** assistant to the deputy commander for weapon systems, Air Research and Development Command.
- **Abraham Hyatt,** research and analysis officer, assistant chief for research and development, Navy Bureau of Aeronautics.

All 16 members attended the initial meeting. NACA Chairman James H. Doolittle and NACA Director Dr. Hugh L. Dryden also participated.

The nuclear submarines for Polaris will be built along the lines of an Albacore hull which follows aerodynamic design principles. They will be powered by water-cooled reactors.

Largest Solid Propellant Engine Static-Fired in Thiokol Fuel Test

By Michael Yaffee

New York—Thiokol Chemical Corp. has static-fired the largest solid propellant rocket engine ever made.

The engine contained over 10 tons of propellants, Thiokol President John W. Crosby disclosed last week at a meeting of the Chemical Industry Assn. Crosby compared the engine with the two largest solid motors previously made, both by Thiokol, one for the RV-A-10 and the other for the first stage of the X-17.

The RV-A-10 engine contained only 4-5,000 lb. of propellant, he pointed out, and the first stage of the X-17 carries about three times that.

Thrust of this new engine, it was indicated, is still less than that of the largest liquid propellant unit now available, the 165,000-lb. thrust Thor engine. But Crosby said his company could build a solid motor as large or larger than the Thor's.

Change in Outlook

At present, solids probably account for less than 10% of the money being spent on missile propellants, but this percentage will increase according to Crosby. This does not mean that there will be a complete swing to solids, since liquid propellants, he said, will continue to be an important factor.

Solids can be easily started, programmed, slowed down by thrust reversers, and cut off, Crosby said. But they still can't be reignited or throttled and so constitute a problem for guidance systems, he added.

Consequently, the primary application for solids remains in boosters. Rocket men will continue to use liquids for sustaining flight. Nuclear-powered engines are "a long way off" and will need chemical boosters to put them in the air, Crosby contended.

Improvement of chemical propellants, Crosby said, will concentrate on solids. The energy of solid propellants, for example, must be increased. Boron, fluorine, and lithium compounds are prime candidates to boost specific impulse. Boron has the edge on the others due to its higher energy potential and because more work has already been done on it. The trend, Crosby believes, is from petroleum hydrocarbons to high energy fuels.

Propellant Improvement

Value of the comparatively new polyurethanes as binders (which also serve as the fuel) in composite solid propellants, offers no overall advantage over the polysulfide elastomers favored by Thiokol. A major drawback to use of the polyurethanes, as far as Thiokol is concerned, is the difficulty in controlling their rapid reaction rate, although they are being used as binders.

Thiokol also is using polymers of butadiene and is interested in all new binder materials that come along. (Allied Chemical & Dye Corp., AVIATION WEEK learned, is supplying isocyanates —which are reacted with alcohols to produce polyurethanes—to both Thiokol and Aerojet-General).

The development of new solid fuels is an expensive gamble, Crosby pointed out. A company has to carry the program into the pilot plant stage before it knows whether or not the new fuel is worthwhile. Right now, for example, Thiokol is producing 10,000 lb./month of a new polymer, and, according to Crosby, it probably will be near the end of 1958 before it can be thoroughly evaluated.

He also disclosed that Thiokol is working on the development of plastic blast tubes and rocket casings. The interest in plastic casings in place of stainless steel stems mainly from safety considerations rather than possible weight savings. The large steel casing from the Nike-Hercules booster creates a sizable potential hazard for surrounding inhabited areas, Crosby pointed out, even though the Army has carefully selected missile flight paths.

On non-military markets for rockets, he cited production of solid propellant charges for use in controlled underground explosions. But at present, all such civilian applications are overshadowed by military needs.

Indications are that Thiokol's new solid propellant rocket engine is being developed for use in an air-launched IRBM now under study by the Air Force (AW Feb. 10, p. 39).

Top USAF spokesmen have referred to the new IRBM as a successor to the WS-132 Hound Dog air-to-surface missile being developed by North American Aviation, Inc., for use with the B-52 and as a third generation offspring from Bell's air-to-surface Rascal now in operation with a Strategic Air Command B-47 group.

Combined with a nuclear-powered bomber which could remain airborne for extended periods, the new IRBM would give the United States a fast, hard-to-detect retaliatory force superior even to Polaris-armed atomic subs.

Convair Space Plan

Washington—Proceeding from the basis of presently-funded WS-117L—Pied Piper, using Atlas booster—Convair has proposed an orderly space program on a step-by-step basis, Aviation Week has learned.

Step following 117L would have a family of more sophisticated satellites put into space to form the basis of a global reconnaissance system.

After the global reconnaissance system would come an orbital glider, a vehicle capable of going into orbit with a man, then returning at a selected time and place.

When problems of people in space have been evaluated and effective solutions reached, a series of supply vehicles and men would be placed in orbit. Vehicles also would be useful in assembling a space station on a piece-by-piece basis, using the vehicles themselves as integral parts of the station. Simultaneously, additional supply vehicles would be sent up that could return with personnel on a regular supply run schedule.

From the space station, space flight would be effected, using ion propulsion and other techniques that have been described in open literature for a number of years.

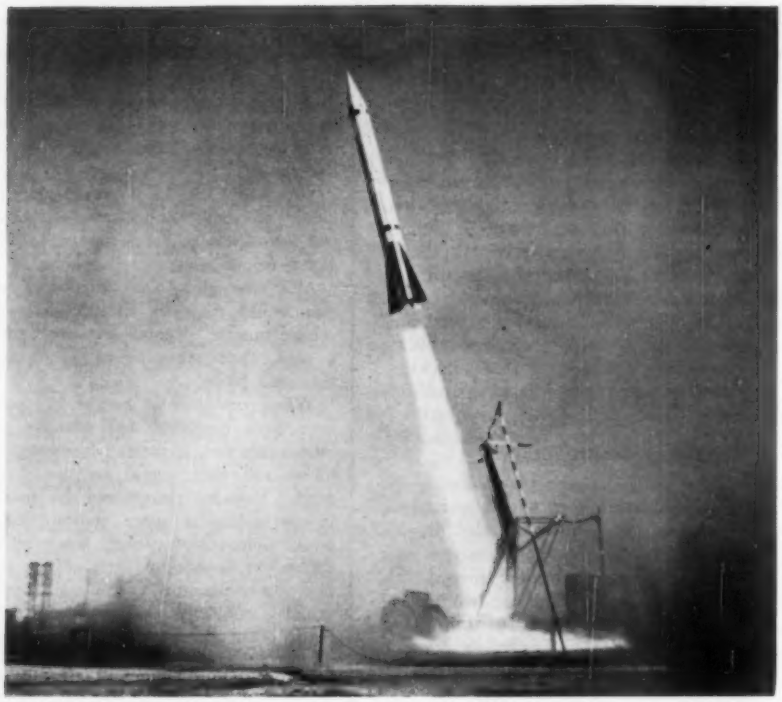
Aircraft Obligations, Expenditures

Washington—New obligations for Air Force and Navy aircraft and related procurement totaled $4.3 billion during the first six months of Fiscal 1958, a figure substantially below the $5.6 billion for the same period of Fiscal 1957. The totals were divided:

- **USAF: $3.2 billion, compared with $4.2 billion for the first half of Fiscal 1957.**
- **Navy: $1.1 billion, compared with $1.4 billion for the first half of Fiscal 1957.**

Expenditures, however, were up: $5 billion total for the first half of Fiscal 1958 as compared with $4.3 billion for the same Fiscal 1957 period. These totals were divided:

- **USAF: $3.8 billion, compared with $3.4 billion for the first six months of Fiscal 1957.**
- **Navy: $1.2 billion, compared with $948 million for the first six months of Fiscal 1957.**



SERGEANT missile is launched at recent test firing at White Sands Proving Ground, N. M. Army says missile guidance system is invulnerable to enemy countermeasures.

Solid Fuel Fires Sergeant Missile

Sergeant surface-to-surface ballistic guided missile with a range approaching 200 mi. is United State's first second-generation tactical missile, according to Army's announcement last week. Sergeant will replace Corporal which has been operational for the last four years, has range of 75-100 mi.

Advantages of Sergeant over Corporal are said to be:

• **Solid fuel.** Missile uses a solid propellant rocket motor of advanced design and increased specific impulse. Motor simplifies both storage and handling problems, improves resistance to temperature, shock and vibration for field use.

• **Mobility.** Missile is about 30 ft. long, has been packaged so all system elements have high portability and mobility. Broken down for transportation, missile can be carried in standard Army vehicles.

• **Self-contained guidance.** Guidance for the missile is a self-contained inertial system that provides invulnerability to all known types of enemy countermeasures.

• **Reliability.** Army says it has demonstrated missile's high degree of reliability in flight tests under all operating conditions. Tests, however, have been with prototypes. No production missiles will be available for several months.

• **Warheads.** One factor in the improved performance of Sergeant not mentioned by the Army is the reduction in size and weight of nuclear warheads that enables smaller and lighter missiles to carry higher yield stores.

Sergeant has been developed for Army by California Institute of Technology Jet Propulsion Laboratory, the same group that developed the Private, WAC Corporal and Corporal and worked in conjunction with Army Ballistic Missile Agency in developing Jupiter-C test vehicle and satellite launching rocket.

Production of Sergeant will be by Sperry Gyroscope Co.'s Sperry Utah Engineering Laboratory, Salt Lake City, where long lead time sub-systems are already in production.

NACA Budget Request Cut by House Group

Washington—House Appropriations Committee late last week cut $2.3 million from National Advisory Committee for Aeronautics' supplemental request for additional funds to finance its operations through the remainder of Fiscal 1958.

NACA originally had asked for $13.8 million in supplemental funds for additional construction and for salaries and administrative expenses. This was cut in November to $11.8 million by the Bureau of the Budget.

In cutting another $1.5 million from the request for salaries and administrative expenses and $780,000 from construction funds, the House Appropriations Committee last week charged that much of NACA's missile research activities overlap those of the military.

The Budget Bureau also has trimmed NACA's Fiscal 1959 request from $138.8 million to $118.5 million. It has not yet been considered by Congress.

At hearings on the supplemental, Dr. Doolittle and NACA Director Hugh Dryden reported that the $11.8 million request would provide for these programs:

• **Personnel increase of 465.** This provides for an employment increase from 7,935 to 8,400 as a step toward the level of 9,000 which Budget Bureau has approved for Fiscal 1959.

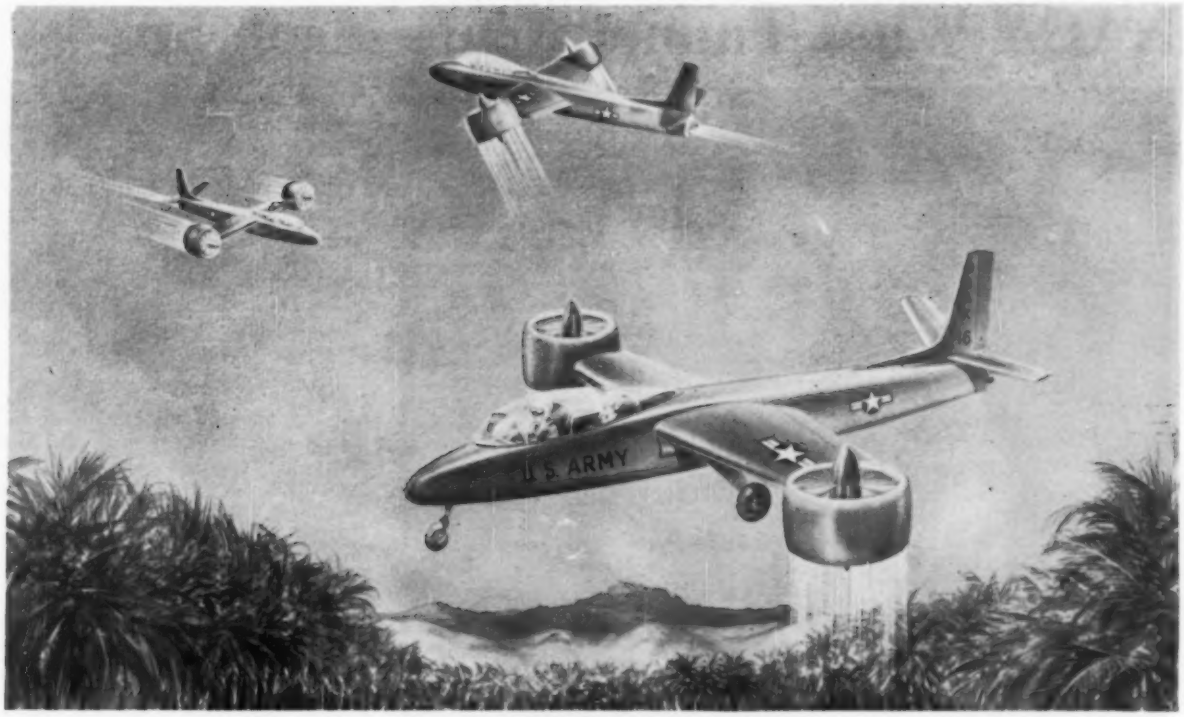
• **Rockets to be used in missile** testings at Wallops Island, Va., station, $1.7 million.

• **Data reduction center at Langley** Aeronautical Laboratory, $3.1 million. The new building would centralize existing data-processing service for three major wind tunnels. NACA has one center at Lewis Laboratory and plans to request funds for a third center at Ames Laboratory next year.

• **Instrumentation of a dynamics systems** research airplane, $1 million. This is for installation of airborne instrumentation in McDonnell F-101 fighter and for matching ground instrumentation and supporting equipment to permit flight studies on various dynamic systems used in high performance aircraft and missiles for flight control, guidance and weapon aiming.

• **Ultra-high-temperature materials facility** at Langley, $2.7 million. This would consist of an air jet heated by an electric arc to stagnation temperatures of 5,000 to 20,000 F, for suitable data-recording equipment and supporting facilities for specimen fabrication and analysis. It would be used to simulate the aerodynamic conditions encountered during the atmospheric entry of a long-range ballistic missile and to study the effects of such conditions on a variety of configurations and materials to determine the most effective means of assuring structural integrity.

Dr. Hugh L. Dryden, director of NACA, pointed out that NACA started Fiscal 1958 last July with 8,052 employes and that the level will continue to decline from the present 7,935 unless supplemental funds are granted. The 465 new employes are planned for: Langley, 174; Ames, 74; Lewis 198; Edwards, Calif., High-Speed Flight Station, 17; and Wallops Station, 2.



Doak Readies X-16 VTOL For Ground Tests

Ground tests are scheduled soon for new Doak X-16 VTOL, which as artist's sketch shows, uses wingtip-mounted ducted fans that can be tilted 90 deg. after vertical takeoff for transition to highspeed forward flight. Ducted propellers are driven by a single 840-shp. Lycoming T53. Ducts are fabricated of aluminum alloy with Fiberglas leading edges and are lined with epoxy resin. X-16, designed for U. S. Army Transportation Research & Engineering Command, can also takeoff and land horizontally in conventional manner; this operation allows carrying greater fuel or payload. X-16 has 25-ft. span, 32-ft. length and 10-ft. height. Takeoff weight is approximately 2,700 lb., useful load 600 lb. Doak Aircraft Co., Torrance, Calif., is the manufacturer.

Strike Near, Sikorsky, UAW Agree

Bridgeport, Conn.—Eleventh-hour negotiations between Sikorsky Division of United Aircraft Corp. and United Auto Workers Local 887 at Bridgeport, Conn., produced a contract settlement, the same day a strike was to begin.

New pact contains some offers made by Sikorsky last December, including a general wage hike from nine to 14 cents an hour. Other upgrading was in sick benefits and changes in arbitration and grievance procedures.

Union dropped its demands for union shop, automatic wage progression and 10% night differential pay after UAW international representative Staig Lindholtz told membership "it would be unrealistic and disastrous to strike over unresolved issues like the 10% differential."

Sikorsky contract fight has been watched by aircraft industry, as an indication whether UAW and International Assn. of Machinists are aligning in a step toward industry-wide bargaining (AW Feb. 17, p. 26). Some observers feel temper of management and labor can be gaged from Sikorsky negotiations.

Indications of UAW-IAM cooperation came in Sikorsky settlement. Union won clause which allows UAW to reopen wage negotiations next year at same time IAM reopens with another United Aircraft Corp. division, Pratt & Whitney, Hartford, Conn.

New contract at Sikorsky runs for two years, with wage reopener in one year. About 4,000 employes at Bridgeport and Stratford plants are affected. New contract includes:

- **Wage increase** with group 1 employes now getting top hourly wage of $3.45.
- **Hospital benefits** raised from $12 to $15 a day, with cost borne jointly by company and employe.
- **Interchangeable seniority** within occupation groups for all employes at Bridgeport and Stratford plants.
- **Broadened number** of issues leading to arbitration and added to contract wording an eighth paid holiday (company had previously allowed the holiday).
- **Provision** that stewards no longer must accept transfers they do not want, and agreement to $4 minimum call-back pay for employes doing temporary custodial work.

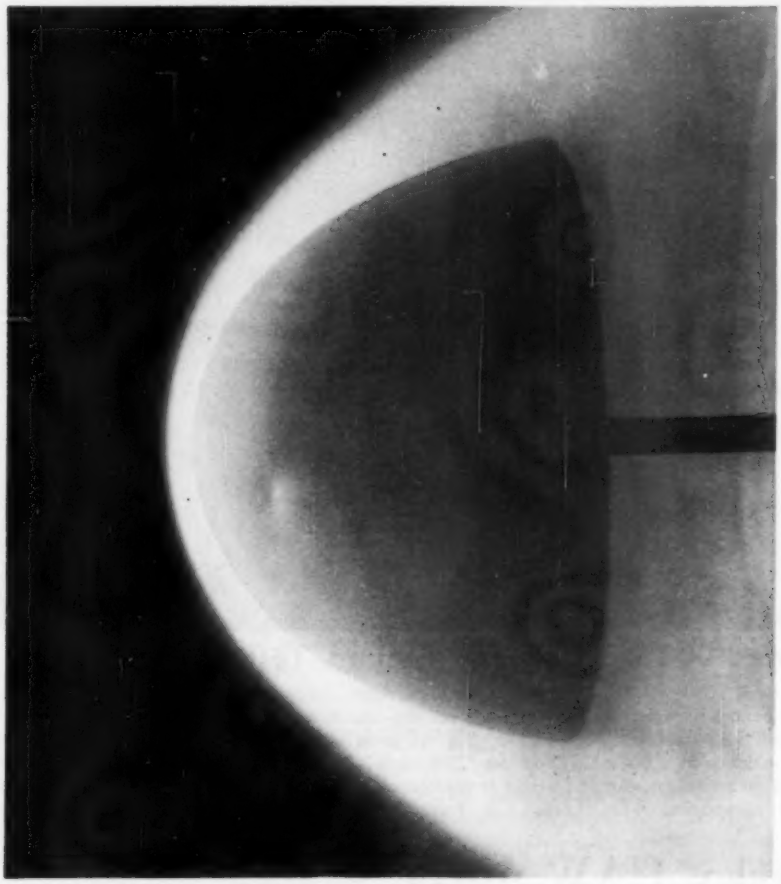
Lindholtz said the arbitration clause was "enough to strike on by itself." Both sides apparently made concessions. Company backed down from demand to limit grievance filing period and extension of time for foreman to answer grievances.

Sikorsky had proposed an interchangeable seniority clause but stipulated union must accept increase in occupation groups from 49 to 100. Union considered this would have "cut drastically" the area in which high-seniority men could "bump" others with less seniority from jobs. Union, however, agreed to addition of eight new groups.

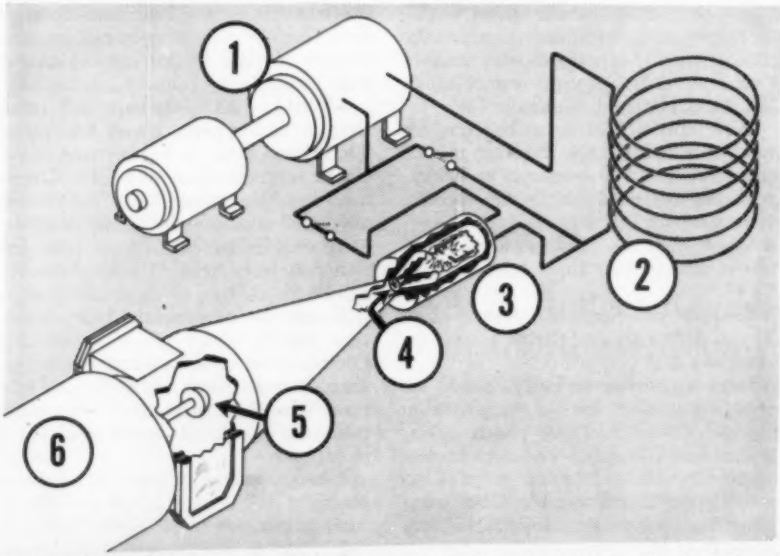
Union spokesman said new arbitration clause allows union to file full grievances on shift transfers, discontinuance of department operations, and on promotions, transfers and job classifications. The latter was considered a major gain.

Sikorsky contract signing (approved by Local 887 vote of 2,765 to 158) follows settlement of strike by IAM-Precision Lodge 797 against Kollsman Instrument Corp. at Elmhurst, N. Y. Company is active in Jupiter-C and Atlas missile program.

NACA Wind Tunnel Nears Mach 50



INCANDESCENCE surrounding Hotshot II missile nose in tunnel test is caused by high velocity air friction. Runs last 1/10 sec., have exceeded escape velocity.



HOTSHOT II unipolar generator (1) feeds current to coil (2) circuits in arc chamber (3) and closes. Plastic seal (4) vaporizes at predetermined temperature and air flows into test chamber (5) past test object in vacuum chamber (6).

Washington—Escape velocity has been exceeded in a wind tunnel for the first time. Velocity achieved is almost Mach 50.

Airflow of 32,400 mph., with temperatures exceeding 40,000F and pressures above 30,000 psi., was achieved for about $\frac{1}{10}$th of a second in calibration and shakedown runs of electric arc tunnel Hotshot II at Air Research and Development Command's Arnold Engineering Development Center, Tullahoma, Tenn.

Still larger electric arc tunnel that may accommodate full-scale missile and spacecraft components is in the final stages of design at AEDC. Some equipment for it already has been bought. It will be designated Tunnel F.

Hotshot II's test section is 50 in. in diameter, large enough to hold very large scale missile components. It is an outgrowth of Hotshot I, which has a 16-in. diameter test section. The first tunnel has been in use for the past year and has tested scale models of the nose cones of the Atlas, Titan, Thor, Polaris and other advanced missile projects.

The record run in Hotshot II is approximately nine miles per second. Velocity required for an object to escape Earth's gravitational force is approximately seven miles per second.

Time Limit

Length of test runs is limited by temperatures and pressures that tunnel components will withstand without melting or vaporizing, but special rapid-response instruments developed for use with Hotshot II record pressure distributions, heat transfer rates, etc., within acceptable accuracies.

Both Hotshot tunnels and Tunnel F are part of AEDC's Gas Dynamics Facility, one of three major laboratories there.

Hotshot II was designed and constructed by ARO, Inc., operating contractor for AEDC. ARO also developed the instrumentation. Allis-Chalmers Corp. developed the unipolar generator used to create the electrical charge that heats and pressurizes air for the tunnel. Westinghouse Electric Corp. built the large inductance coil which momentarily stores the charge.

Airflow is produced by discharging a powerful electric arc in a small chamber. Operation begins when the unipolar generator feeds electric current to the inductive storage coil.

A circuit in the arc chamber is closed while a magnetic field of sufficient strength is built up in the coil. When energy reaches the desired level, a circuit breaker in the arc chamber is pulled, producing the arc through in-

stantaneous collapse of the magnetic field.

Arc heats air in the arc chamber and, at a predetermined pressure and temperature, a thin plastic diaphragm separating the chamber and the tunnel throat vaporizes, releasing the airflow into the main tunnel and test section.

Arc chamber is 4 in. in diameter. Conical nozzle of the tunnel expands from $\frac{1}{16}$th of an inch diameter at the throat to 50 in. at the test section.

Air pressure in the arc chamber is raised to 500-2,000 lb. psi. before firing, and air in the main tunnel is reduced to one-millionth of an atmosphere.

Use of the storage coil eliminates the need for large numbers of capacitors used in Hotshot I. The earlier tunnel generates test velocities ranging from Mach 10 to Mach 20, frictional temperatures of more than 15,000F and pressures above 20,000 lb. psi.

Construction of Hotshot II began in the spring of 1956. It has been under development for the past year. As Hotshot II goes into operational service for Air Force, Navy, Army and industry contractors, Hotshot I will be used for further investigations leading to development of Tunnel F. Tunnel F will be built under supervision of the Army's Tullahoma District Engineer.

Length of the test run in Hotshot II is substantially longer than those made in other tunnels in this speed range, Air Force said, and pressures and temperatures produced far exceed those recorded in other tunnels.

Canadair, Lockheed Order Fairchild J83

New York—Fairchild J83 lightweight turbojet will power prototypes of Canadair's new CL-41 side-by-side trainer on flight test program by spring of 1959. Contract marks first export order for the 2,000-lb.-thrust J83, which will power Fairchild Bull Goose missile for Strategic Air Command.

Canadair designed its CL-41 to use any of several types of small U.S. and foreign turbojets, including General Electric's J85; indications are that a major factor in choosing the J83 was favorable delivery date. The airframe manufacturer will probably get deliveries late this year. First disclosure of specifications on the J83 show it to be approximately 67.5 in. long and having an 18 in. dia.

Lockheed has decided to order a small number of J83s for pre-production test and evaluation in the Jetstar utility transport. The four-engine J83 layout will be compared with the twin-engine Curtiss-Wright TJ37 (Bristol Orpheus) and probably with a four-engine GE J85 configuration.

Executive Scores Arsenal Concept

New York—Application of the arsenal concept of development in complex weapon systems such as aircraft and missiles is "unthinkable," the president of North American Aviation, Inc., said here last week.

J. L. Atwood, speaking to the New York Society of Security Analysts, contended the arsenal concept, with respect to complex systems, "achieves non-duplication of effort at the price of technical stagnation, consistence at the price of prolonged delays, and job security at the price of inefficiency."

He backed the present competitive system of the aircraft-missile industry "monitored and guided by the responsible operational and procurement officials of the armed forces.

"The industry," Atwood continued, "is being squeezed today between two conflicting influences emanating from the federal government." He said these are:

- **Defense Department** and services urging the industry to step up to its proper place in the national economy and defense structure by undertaking a greater share of financial responsibility.
- **Contradictory government** policies effectively hamstringing the industry in its efforts to live up to its responsibilities.

Atwood claimed "repressive policies" are spearheaded by the Renegotiation Board with "its unique legislative charter that permits five men to decide arbitrarily what amount of profit is reasonable for defense industry." Los Angeles Regional Renegotiation Board has tentatively determined a North American refund to the government of $5,500,000, with regard to Fiscal 1954 operations.

The speaker asserted "in the long run the national interest will suffer if the most competent industrial organizations are discouraged from participation in defense work. He expressed the hope the Renegotiation Act will be permitted to expire at the end of 1958.

Turning to North American's operations, Atwood said the company now has 49,000 employes, a reduction of about 22,000 persons since last summer, a decline which "tells its own story of the trend of our business since the high year of 1957, when sales were more than $1 billion.

Atwood forecast 1958 sales of $750 million and said he is confident North American will get back in the billion-dollar sales class "although it may be some time before we can equal the results of 1957."

The president said employment at company's Los Angeles Division will continue downward in 1957 until production starts on F-108 long-range interceptor and WS-110A weapon system, won in competition with Boeing Airplane Co. Atwood said there also are "possibilities" for Sabreliner twin-jet plane now under construction as company venture to meet military requirements. Los Angeles Division has been concentrating on F-100 program.

At Columbus, Ohio, division, where North American employs 10,500, production has concluded on F-100 and Navy contract for FJ-4 jet fighter will be completed this summer. Division is producing T2J-1 jet trainer for Navy and is developing A3J-1 carrier-based attack weapon system.

Company employment was severely curtailed at Missile Development Division, Downey, Calif., when Navaho missile termination resulted in cut from 7,000 to 2,000 employes. Division now is developing air-to-surface missile for Boeing B-52 bomber.

Navaho termination also affected Autonetics Division at Downey because of extensive guidance and control work programmed for Navaho. Employment there now is 5,600, although Atwood said Division is building up gradually on autonavigation systems, radar systems and computer and automatic control projects.

Continued growth at Rocketdyne Division, with plants at Canoga Park, Calif., and Neosho, Mo., "reflects increasing emphasis on missile and space programs," Atwood said. Employment is more than 11,000 and is increasing gradually to meet ballistic missile schedules. Another division, Atomics International at Canoga Park, employs 1,700 persons in what Atwood said is the largest private nuclear development organization in the nation, working on non-military nuclear power applications.

News Digest

First Pacific Squadron of F8U-1 fighters will join the U.S. Seventh Fleet. Fighter Squadron 154, which is assigned the aircraft, is deployed aboard the carrier U.S.S. Hancock, scheduled for duty with the Pacific fleet.

Jet aircraft in-flight refueling has been carried out for the first time in France. The aircraft, an SO. 4050.02 Vautour, was refueled by a Canberra of the Flight Refueling Co. Vautour also is undergoing tests to check handling characteristics up to Mach 1.2, and flight tests with different wing loadings including Nord Aviation air-to-air missiles.

CAA Wins Battle for Airspace Control

New office is created to allocate airspace as climax of bitter civil-military dispute; Quarles letter a key.

By L. L. Doty

Washington—Civil Aeronautics Administration last week took first steps toward implementing its newly-won power to control all U. S. airspace.

Climaxing a bitter fight between civil and military aviation for America's rapidly disappearing airspace, Civil Aeronautics Administrator James T. Pyle announced the creation of a new office of assistant administrator of airspace with Halford Noggle as its head. Under Pyle's jurisdiction and subject to a review by the Civil Aeronautics Board, the new office will be responsible for the allocation of all military restricted, prohibited and off-shore warning areas and commercial airways.

Ruling giving CAA control of all airspace becomes effective in April.

Noggle, who has been with the CAA since 1946, was assistant general counsel for the agency prior to his present appointment. Emerson R. Nehrling, chief of the Airspace Use Branch of the Office of Air Traffic Control, has been Noggle's deputy.

The action represents a victory for civil aviation factions which, for more than a year, have violently protested military designation of huge blocks of airspace as off-limits to non-military aircraft.

Defense Protest

Defense Department protests of the proposed ruling were equally as vigorous as late as last fall (AW Nov. 4, p. 37). In a critical response to the Board's draft release covering the ruling, the Defense Department challenged the legal right of either the CAB or CAA to control airspace. It also questioned the existence of any crisis in the use of airspace.

Later, Defense Department boycotted a meeting held in Washington on Nov. 6 by the Board as a means of breaking the deadlock through a detailed discussion of technical problems involved. On Feb. 7, the military relented and in a letter to the Board signed by Deputy Defense Secretary Donald Quarles said, "It is the view of the Department of Defense that the Board has appropriate legal authority to issue this regulation."

Some observers attribute this reversal of position to an earlier letter, also signed by Quarles, denying any conflict between military and civil flight rules in the mid-air collision between an F-89J and a DC-7C near Van Nuys, Calif., on Jan. 31 (AW Feb. 11, p. 38). The letter, which came to light during a White House conference last year on the airspace controversy, passed the responsibility of air traffic control to the Civil Aeronautics Board.

Letter to Kuchel

Addressed to Sen. Thomas H. Kuchel (R.-Calif.) in response to a query as to where responsibility rested in controlling the two aircraft, the letter read in part:

"In conducting flight through airspace above the continental U. S., its territories and possessions, the military departments recognize and comply with the rules promulgated by the Civil Aeronautics Board under the authority contained in section 601 of the Civil Aeronautics Act of 1938."

The new ruling will strip the Air Coordinating Committee's Airspace Use Panel of all authority to make a final allocation of airspace. However, under Pyle's organization plan, the panel will screen and process all requests for airspace from both civil and military aviation groups before they are submitted to Noggle for review.

Air traffic supervisors will be appointed by the CAA to cover each of the agency's air route traffic control centers throughout the U. S. One of the functions of the supervisors will be to monitor the utilization of airspace within their designated areas.

Conflicts will be submitted to CAA regional offices by the supervisors for review. Public hearings will then be held by the area Airspace Use Panel and findings will be submitted to the Airspace Use Panel in Washington. Final action will be taken by the new CAA airspace office where both civil and military aviation groups will have an opportunity to be heard on any applications for airspace allocation or on conflicts over present assignments.

Both existing airways and areas assigned to the military services will be reviewed and monitored by the new office. At present, 116,816 sq. mi. are allocated as restricted area, 3,637 sq. mi. as prohibited area and 377,178 sq. mi. as off-shore warning area.

In revising the ruling, the Board recognized that, under certain circumstances, it may be necessary for the military to conduct operations that cannot comply with the Civil Air Regulations. As a result, the regulation permits military aircraft "to deviate from the air traffic rules when appropriate military authority determines that noncompliance is required by military emergency or current military necessity essential to the defense of the United States and prior notice thereof is given to the administrator."

'Non-Compliance' Protest

It is the "non-compliance" section of the ruling that drew some mild protests from civil aviation groups who, otherwise, strongly supported the measure. Milton W. Arnold, Air Transport Assn. vice president-operations-and-engineering, said only "time will tell about the manner and method intended" in the non-compliance phrase and added:

"To prevent abuse of this exception to the proposed rules, it is suggested that the CAB investigate methods or procedures by which the Board can evaluate the use made of the exception by the industry."

Air Line Pilots Assn. expressed similar doubts and charged that military reserved space has been used infre-

American Reshuffle

New York—American Airlines' directors last week reshuffled the carrier's upper echelon jobs in a move aimed at "strengthening the organization of American and better preparing it for the planning and operations incidental to jet air transportation," according to President C. R. Smith.

Changes include establishment of three executive vice presidencies. To fill one of them, Charles A. Rheinstrom, a former American vice president-sales until 1946 and currently a J. Walter Thompson advertising agency vice president, will return, becoming executive vice president-sales. In this capacity he will be assisted by Charles Speers, the airline's senior vice president-sales. Two other senior vice presidents—O. M. Mosier, operations, and William J. Hogan, finance and planning, will become executive vice presidents. The airline's fourth senior vice president, C. W. Jacob, will keep his title of senior vice president and secretary.

The changes are scheduled to become effective April 1.

quently and under certain specified weather conditions during certain hours of the day. The pilots' group called for an examination of the "type and amount of usage" of restricted military airspace.

Most observers now feel, however, that the requirement of prior notice of any deviation from air traffic rules will eliminate serious conflicts that could threaten air safety. Previous air traffic rules did not specify conditions under which military aircraft could deviate from air traffic rules.

In addition, the Board has emphasized that the intent of the new ruling is to conduct most military flights such as training operations under the terms of a waiver issued by the administrator and not under non-compliance authority. The Board explained that the rapid increase of air traffic of all types has "created increasing problems in resolving conflicts in the allocation of airspace . . ." and added:

"The problem of diminishing airspace has become so acute that the government can no longer accommodate all of the needs of individual users without judiciously weighing the interests of all users to determine what is most in the public interest."

Flight Safety

Under the regulation, the Board delegates authority to the administrator to designate restricted areas whenever such action is considered necessary to the safety of aircraft in flight. The administrator may also "impose such terms, conditions, and limitations as he may deem necessary, and may modify or revoke such designations when required in the public interest."

The Board ruled that the administrator will comply with the provisions of the Administrative Procedure Act in exercising the airspace authority. This will insure all interested parties a full and complete opportunity to participate in the rule-making process.

In addition, the Board reserved a right to review—on its own initiative—any action taken by the administrator. Final appeal from any decision taken will be the White House.

In passing on the legality of the ruling, CAB general counsel Franklin Stone found no legal flaw in the regulation and concluded that "no one user is absolutely entitled under all circumstances through its own unilateral action and operation to render the airspace unsafe and thus to occupy it to the exclusion of all others; all must be accommodated to the extent possible."

Engineer Hearing Main Issues Delayed

By Glenn Garrison

New York—Development of the two main issues in the contract dispute between Flight Engineers International Assn. and Eastern Air Lines was postponed last week when an emergency board hearing the case adjourned until Feb. 27 and shifted the locale from New York to Miami, Fla.

During a week of testimony here, the engineers presented part of their case but have not yet delved into their demand for a "job security" contract clause specifying FEIA flight engineers in future cockpits, or into their pay demands.

The three-man board, with Air Line Pilots Assn.'s overlapping dispute with Eastern still to be heard after the flight engineer's case is finished, has asked and received President Eisenhower's approval of a 30-day extension for filing a report. The emergency board, set up Jan. 21, had 30 days in which to file in the engineer's case. Its members are David L. Cole, chairman; Saul Wallen, and Dudley Whiting.

Engineer's Evidence

During the New York sessions, the engineers sought to establish the present and future need for professional, mechanic-trained flight engineers in transport aircraft crews. The union wants Eastern to agree to a contract clause specifying that a flight engineer or flight engineers on a seniority list provided for in the agreement be used on all flights of aircraft of over 80,000 lb. gross weight and on all other flights of any aircraft in which a flight engineer is used by the company and-or as required by government regulation.

Cole suggested that the engineers' evidence aimed at showing that the flight engineer is essential now and will be even more so in jets, had no bearing on whether FEIA or ALPA should represent the engineers. It did, however, relate to the wage dispute, Cole said.

George R. Petty, Jr., president of FEIA, described as vital the flight engineer's role in jet and turboprop operation. The engineers contend that jet operation will be more complicated than piston planes and will require greater skills from the flight engineer.

Petty ran into sharp challenges on this point from Eastern's W. Glen Harlan. The FEIA president said Boeing had advised him that the flight engineer's job on the 707 jets would require a "greater technological background" than at present in piston aircraft. Harlan countered that brochures and sales literature put out by the jet manufacturers stressed their comparative simplicity.

FEIA entered as an exhibit a paper attributed to B. A. Martin of Lockheed Aircraft, chief test pilot for the C-130 program and now in charge of the atomic bomber project at Marietta, Ga., according to the engineers.

Flight Security

This 1954 paper predicted that the flight engineer will assume responsibility for the security of jet flights and become a system manager.

Job of the flight engineer, according to the exhibit, was at first primarily physical—he simply acted as another pair of hands for the pilot. This situation soon changed, the paper said, because the pilots, not being required to operate power plants and systems, lost some of their familiarity with these related operations and leaned more and more heavily on the engineer. In jet operations, the contribution of the pilot to the security of the flight will diminish, the exhibit said.

Besides the matter of the flight engineer's importance, working conditions were a major part of the FEIA presentation to date. Jack Robertson, chairman of Eastern's chapter of the union, was the chief witness in this area.

Hearing Issues

Among the issues covered in this testimony were:

- **Flight hours** per month—FEIA wants a guaranteed minimum of 70.
- **Deadheading**—the engineers want full pay instead of half pay when deadheading to or from assignments. They also want Eastern to provide "positive" reservations on the first available flight to an engineer deadheading back from a flight. Practice now, according to the testimony, frequently involves waiting with standbys at the gate and sometimes losing space to a revenue passenger standby.
- **Time off**—engineers seek four-week vacations, minimum of 48 hr. off duty before start of vacation, minimum of 48 consecutive hours off each month.

After the board hears the balance of the engineers' presentation and Eastern's response, the pilots' case will begin. The ALPA-Eastern fact finding board—actually the same men hearing the present case—was set up Jan. 28. Obviously an extension of time will be required in this report, too, as ALPA's case will hardly have begun at the end of the original 30-day period.

The engineers are seeking an average pay hike of 18%. Eastern offered 3%, then went up to 5%.

Tupolev Tu-114, with one engine turning over, is parked next to An-10 Ukraine at a Russian airport. Tail of the An-10, a four-engine turboprop designed for Aeroflot's rough field feeder operations, shows addition of outboard fin on stabilizer, indicating directional stability problems. Heater truck under nose of Tu-114 is typical of ground heating equipment at Russian airports.

First Flight Photos of Soviet Tu-114 Turboprop

Tu-114 and other new Russian turbine-powered transports and the technology behind them have been described by Donald Douglas, Jr., as a serious threat to present U. S. position as top world supplier of commercial aircraft. The 12,000 eshp. Kuznetsov Kniz engines which power the Tu-114 probably represent the greatest U.S.S.R. lead in the transport field, as the West has no similar engine.

Planform view of the Tu-114 indicates that the aircraft has generally the same wing sweep as the Boeing 707 and the Douglas DC-8. However the Tu-114's wing appears to have a higher aspect ratio which would make it more efficient for long range flight. Three fences are located on each semi-span to reduce the spanwise flow. Note change in taper ratio.

Spacious dining accommodations are features of Aeroflot's Tu-114 service. Table can seat six persons easily (above, left). At right, stewardess and chef prepare meal trays in aircraft's galley. Restaurant design has eight tables.

He does the mile in 7.4 seconds

...so you can do it in 6!

His name is André Lesieur. He's just pushing 40. And he hasn't run a mile since his schooldays. But he's flown many millions of miles...at the controls of Air France airliners. Doing the mile in 7.4 seconds is just routine for André. It's the average cruising speed of his Caravelle jet. Soon he'll be flying a six-second mile across the Atlantic (and you can, too!) in new Air France Boeing 707 jet airliners! Captain André Lesieur has over 10,000 flying hours, over 120 Atlantic crossings to his credit.

But he doesn't consider himself exceptional. All Air France pilots have similar records. That's why you can fly in comfort with confidence on Air France.

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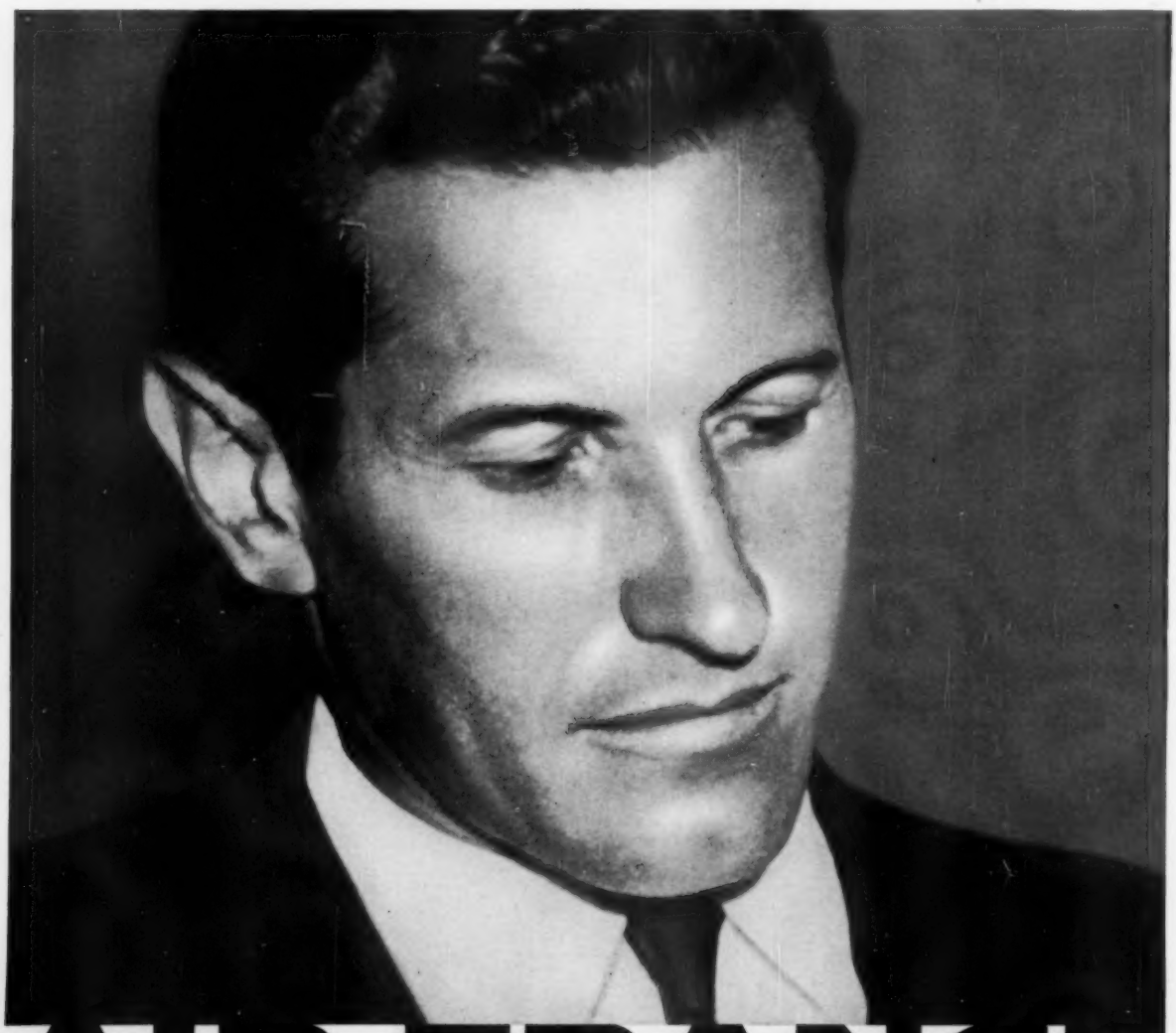
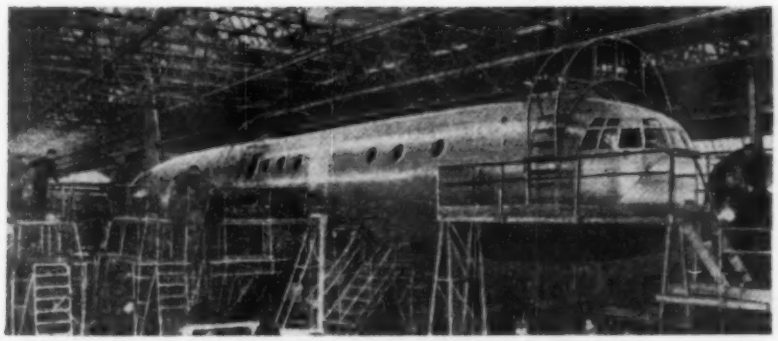


AIR FRANCE



RUSSIA'S four-turboprop Il-18 Moscow transport has been placed in assembly-line production at Moscow's Ilyushin plant. The new plane, which is scheduled to go into regular airline service this year, is being built in a section of the factory formerly used for manufacturing twin-engine Il-14s.

Il-18 To Fly Moscow-Vladivostok

Moscow—Continuing its new emphasis on low operating costs, Russia's state-owned airline, Aeroflot, is now looking beyond the Tu-104 turbojet transports for a more economical airplane to serve its long-haul trans-Siberian routes.

With traffic rising spectacularly all along the Far Eastern route, the Soviet carrier plans to rush the Il-18 Moscow turboprop into service by summer or late fall. Aeroflot's officials point out that the Il-18, which will be built in 75 and 100 passenger versions, can fly from Moscow to Vladivostok at "half the cost" of the 50-passenger Tu-104.

Low Cost

A similarly strong note of low operating costs has been placed by the Russians on the Tu-114 turboprop transport (AW Feb. 17, p. 38).

Cruising speed of the Il-18 is about 400 mph. as compared with 500 mph. for the Tu-104 and 600 mph. for the Tu-114. However, the Il-18, which has a 3,100-mi. maximum range, can make the Vladivostok run with only one stop, compared to a minimum of two for the Tu-104.

If necessary, the Il-18 can take off or land at any Siberian field capable of handling the twin reciprocating engine Il-14.

The Tu-104 requires considerably larger airports.

Route Check

On a Moscow-Vladivostok proving run last month, a Tu-104 covered the 5,000 mi. in nine hours, 35 minutes flying time. It made stops at Omsk, Irkutsk and Khabarovsk. Scheduled time of the Il-18 will be about one hour longer.

According to Russian sources, high operating costs of the Tu-104 would be tolerable if Aeroflot's trans-Siberian traffic had remained at the comparatively light volume of three years ago. But both cargo and passenger traffic between the Far East and Moscow is climbing rapidly.

Complete traffic statistics are unavailable. In 1957, however, almost 25,000 foreign passengers alone stopped at the central Siberian city of Irkutsk on Aeroflot flights as compared with only 8,000 in 1955. Most of this international traffic was headed to or from China, North Korea, Communist Viet Nam and Burma.

Construction of the huge Bratsk hydroelectric plant near Irkutsk, discovery of the Yakut diamond fields, increased Siberian oil, gas and metal prospecting and large-scale fur trapping have added to Aeroflot's Far Eastern traffic boom.

Decline in Passengers Continues in January

Washington—Passenger load factors on domestic trunklines continued to decline in January following a downward trend that began almost two years ago.

Revenue passenger load factors for the carriers' January operations dropped to 59.06%—a decline of 1.40 percentage points from January, 1957. Monthly load factors have shown an increase over corresponding months of the previous year only three times in the past 22 months.

However, the January load factor represents a recovery from a decline experienced by the airlines in November when the load factor fell to a low 55.28%.

Available seat-miles continued to rise spectacularly and, for the 12 months ended in January, passed the 40 billion mark for the first time, a 17.3% increase over the same period in the preceding year. During the same period, revenue passenger-miles increased 12.6% to reach an all-time high of 24.65 billion.

Revenue passenger-miles for January totaled 2.08 billion compared to 2 billion in December and 1.79 billion in November. Available seat-miles in January were 3.52 billion, a 12.1 increase over the previous January.

Concession Contract Given to Interstate

Los Angeles—Board of Airport Commissioners of Los Angeles, after three and one-half months study, have authorized lease and operating agreement negotiations with the Interstate Co., nation-wide restaurant and giftstand operator, to operate the concession of restaurants, cocktail lounges and news-giftstands in the new Los Angeles International Airport (AW Dec 2, p. 41).

This action by the Board of Airport Commissioners directs the Department of Airports Management to draft a lease and operating agreement with Interstate. After the commission approves the lease, it will go to the City Council for approval.

Interstate, now headquartered in Chicago, proposes to pay the Los Angeles Department of Airports 10% of gross food sales, 15% on "on sale" alcoholic beverages, 10% on "off sale" bottled liquor and 12% on news-giftstand items. The company offers a minimum guarantee ranging from $700,000 in the first year, 1960, to $1,625,000 in the 10th year for a total of $11,075,000 for the 10-year period.

Interstate also proposes that all profits in excess of 8% on gross revenue be divided equally between the city of Los Angeles and Interstate. As part of the proposal, Interstate will move its corporate headquarters to Los Angeles within 12 months after signing the lease agreement.

The company says it will invest between $1½ million and $2 million for equipment and leasehold improvements, including interior decoration. The concession consists of one center complex restaurant, a restaurant for each of the six satellite terminal buildings, six satellite cocktail lounges, a "Sky High" cocktail and food facility, an employes cafeteria and six satellite news-giftstands.

Other firms that submitted proposals were Hilton Hotels Corp., Fred Harvey Co., Union News Co., Sports Service Corp., Airport Concessionaires Inc., Paul S. Cummings (Huddle Restaurants) and Rexall Drug.

Interstate also has airport restaurant concessions at San Francisco International, Sacramento Municipal, Charleston, W. Va., airport; Detroit, Wayne-Major; New Orleans Moisant, plus gift shops in various other airports.

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LOCAL SERVICE VISCOUNT

. . . a new short-sector aircraft to meet the high-frequency and economy demands of local service routes.

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27 airlines report, "wherever the Viscount flies, traffic figures rise"—an average of 35%. Reason: jet-prop's smooth, silent speed and comfort. Viscount is the plane *more* passengers ask for by name.

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Accommodations for up to 65 passengers. Handsome interior furnishings are exceptionally hard wearing. Carry-on baggage racks are provided.

Low Operating Costs

As demonstrated by actual airline experience, Viscount operational costs are lowest of all modern 4-engine aircraft. The new local service Viscount will be highly economical even on the shortest routes.

Routing Flexibility

Can operate from 5000′ runways (shorter with slightly reduced weight) . . . can fly up to 5 short sectors without refueling or ground servicing.

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In this Viscount development special attention has been paid to the conditions of low-level operation. The landing gear and systems operated in the landing and take-off cycle are particularly rugged.

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Cargo can be loaded while #4 engine is running, driving generator and hydraulic pump, permitting internal starts . . . underwing fueling (in addition to overwing) . . . integral passenger steps hydraulically operated.

Further Information . . .

For a complete cost analysis of *your* specific routes by an experienced Vickers engineering team, call or write: Christopher Clarkson, U.S. representative, 10 Rockefeller Plaza, New York 20, N. Y.

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VICKERS LOCAL SERVICE VISCOUNT

POWERED BY FOUR ROLLS-ROYCE DART ENGINES

VICKERS-ARMSTRONGS (AIRCRAFT) LTD., WEYBRIDGE, ENGLAND • MEMBER COMPANY OF THE VICKERS GROUP

Pan American Markings—Old and New

Pan American World Airways is repainting more than 140 aircraft and hundreds of ground service units to what company calls its "New Look." New paint job, shown on these two Super Stratocruisers at New York International airport, has light blue stripe running length of white fuselage with "Pan American" lettered in black above windows. Tail is marked with 8-ft. dia. blue globe with "PanAm" in white.

BOAC, BEA Overlap To Beat Competitors

London—British Overseas Airways Corp. and British European Airways have signed an agreement allowing them to operate in each other's territory. To compete with foreign airlines, BOAC will operate through any point in Europe. In return, BEA will be allowed to expand its services to Cairo, Beirut and Tel Aviv. BEA will also operate services in the Persian Gulf on behalf of Cyprus Airways.

The airlines said it had now become necessary for BOAC to step up its activity in Europe, but that it did not want to deprive BEA of business. "If BOAC is given necessary freedom, it seems equitable that BEA should be given the opportunity of obtaining an equivalent amount of work outside its own territory," a joint statement said.

The area most suitable for BEA's expansion, the statement added, was the eastern coast of the Mediterranean, and natural terminals for extending its routes to southeast Europe were provided by Beirut, Tel Aviv and Cairo.

In the past, revenue received by both airlines from operations on common ground has been pooled.

George Giles Named Riddle Airlines Head

Miami—Riddle Airlines, Inc., directors have elected George L. Giles president to succeed John Paul Riddle, who becomes chairman of the board.

Spokesman for the airline had no explanation last week as to why the change was made, but said a statement would be forthcoming shortly. The all-cargo carrier has been experiencing financial troubles in developing new routes awarded in 1956 by the Civil Aeronautics Board.

For the fiscal year ended June 30, 1957, Riddle showed a net operating loss of $1,305,283 on revenues of $11,170,847. Following an aggressive development of the new route pattern (AW Nov. 26, 1956, p. 41), traffic failed to meet expectations and last December the airlines asked to suspend services temporarily at Boston, Philadelphia, Jacksonville, Cincinnati and Cleveland. No action has been taken by the CAB, and Riddle now is flying one schedule a week to these points, plus demand trips.

Last fall the carrier sought to increase its common stock from 7½ million to 15 million shares. Request still is before the Security Exchange Commission. Arthur Vining Davis, owner of 51% of Riddle stock, has advanced $1,008,000 toward pro rata purchase of new shares.

Giles, most recently engaged in business in Puerto Rico; from 1952 to 1954 was personal representative of the Secretary of Defense in airport construction work for NATO.

Model Shows VC-10 Slats

New photo of model of Vickers VC-10 long range jet transport shows mounting of four Rolls-Royce Conway engines at tail, with suppressors. Also visible is outline of full span leading edge slats, and flaps and spoilers on trailing edge.

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For a perfect Arizona holiday stay at one of these distinguished hotels. For reservations, write or wire the hotel of your choice or see your Western Travel Agent.

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Great news! Western's famous Champagne Flights now serve Phoenix—and what a holiday you can have at its wonderful resorts! Relax in the sunshine – enjoy swimming, golf, riding. You'll get a wonderful desert tan and a new lease on life.

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SHORTLINES

► **Allegheny Airlines** reports that it flew over 77,011,000 revenue passenger-miles last year. The airline registered a 136% increase in air freight and a 25% increase in air mail.

► **British Overseas Airways Corp.**, which recently marked its first anniversary of Bristol Britannia service, says the turboprop transports have carried nearly 77,500 passengers and flown some eight million miles during 26,000 hours on revenue earning services. First Britannia service was to South Africa. U. S. service was begun a few months ago.

► **Civil Aeronautics Board** has granted Purdue Aeronautics Corp. an exemption permitting it to operate emergency cargo charter flights in foreign air transportation between Aurora, Ill., and Anderson, Ind., and Oshawa, Ont., Canada until November.

► **Delta Air Lines** reports that revenue passenger-miles last year showed a 16% increase over 1956, resulting in a passenger load factor of 57.76%. Gross revenues also increased 16%, but net earnings were down to $289,000 as compared with $791,138 earned in 1956.

► **Irish Airlines** is scheduled to begin transatlantic service on April 28 using three Lockheed 1049H Constellations leased from Seaboard & Western Airlines. The Irish carrier will operate three flights a week at first, increasing to daily flights as the summer tourist season increases. The flights will operate between New York and Shannon and Dublin. Henry W. Held has been named vice president (U.S.A.) to handle sales and administration and will locate in New York at the Irish House, 33 E. 50th St. Held was formerly traffic and sales manager for LAV—the Venezuelan Airline.

► **Lake Central Airlines** carried 164,618 passengers 25,171,338 revenue passenger-miles during 1957, up 17% and 21% respectively over 1956. Passenger revenues were up 19% at $1,573,208.60.

► **San Juan International Airport**, Puerto Rico, handled 986,619 passengers during 1957, a 15% increase of 132,364 over 1956. Revenue air cargo increased in 1957 to 42.6 million lb., 23% above the 34.5 million lb. handled in 1956.

► **United Air Lines'** directors have declared a quarterly dividend of 12½ cents per common share, payable March 15 to stockholders of record as of Feb. 14.

AIRLINE OBSERVER

► Airlines are girding for a bitter round of labor negotiations this spring as unions begin to lay the groundwork for new demands tied-in with the operation of jet transports. One airline, Eastern, already has met in emergency negotiations with three of its unions—Air Line Pilots Assn., Flight Engineers' International Assn. and the International Assn. of Machinists. The latter union has set a March 2 strike date against both Eastern and United. Western and American are involved in emergency proceedings with ALPA in last-ditch attempts to stave off strikes. Strike threats will undoubtedly increase this year since airlines, caught in a profit squeeze as a result of mounting expenses, will not be so quick to compromise as they have been in the past.

► **France has agreed to renew discussions pertaining to its bilateral air agreement with the U. S. and talks are scheduled to be resumed in March. However, most observers suspect that France will be cool to a U. S. proposal that traffic rights to Houston be relinquished in exchange for a route to the West Coast (AW Feb. 17, p. 25).**

► Civil Aeronautics Board has reversed its decision to tighten restrictions on airline free-pass practices. The Board's original decision late last year to place a new interpretation on the section of the Civil Aeronautics Act governing free air transportation drew violent protests from airline employes throughout the industry (AW Dec. 30, p. 34). The Board now admits that many of these practices "are of long standing and some of them appear to have become imbedded in the industry's labor relations structure." Current interpretation of the law will be suspended until Sept. 1 to give Congress an opportunity to consider the free pass problem.

► **Bonanza Air Lines has asked the Civil Aeronautics Board for a guarantee of a $4.3 million loan from the First National Bank of Nevada at a 5½% interest rate for 10 years. The loan, to be granted under the recently approved Equipment Guarantee Loan Act, will be used for the purchase of six Fairchild Friendship F-27 turboprop transports.**

► Port of Portland (Oregon) has demanded the removal of Air Force interceptor operations from Portland International airport. The Port claims that the airport's use and development for civil purposes will be restricted as long as the interceptor squadron remains. It charges that a proposed safety corridor separating Century series jet fighters from private and commercial aircraft would cause "more flight delays than ever in the Portland area."

► **Air India International technical mission, headed by the airline's general manager, is talking with Aeroflot representatives in Moscow on the possibilities of an air agreement covering direct air service between Moscow and New Delhi via Kabul. Discussions between the two airlines are the result of an invitation extended to India's nationalized airline by the Russians.**

► Railroads can be expected to cut freight rates in a move to recapture their former share of the inter-city freight market. Freight traffic volume has declined steadily during the past decade and rail officials now feel that the loss can be attributed to the consistent climb of freight rates since 1945. Although initial rate cuts will be confined to a limited number of commodities, the revised rate structure, if successful, may be expanded to cover a wide scope of shipments.

► **Edo Airborne Loran has been selected as a basic long-range navigation system for turbine-powered transports by Pan American World Airways, Qantas, British Overseas Airways Corp. and Cubana. Command control and three-inch scope of the Edo Loran equipment scope are installed in the cockpit for pilot operation.**

► American Airlines is introducing a teletype system of issuing tickets to large users of transportation. Teletype is connected with a receiver modified to accept a continuous seven-part ticket form. Receiver, located in the company purchasing the transportation, issues flight coupons for the passenger, auditors' coupon to be returned to American with payment and a coupon for the purchaser's record.

45 TONS PER HOUR—In northern Norway, pilots of the U. S. Army's 8th Helicopter Battalion carried loads of building materials, steel, electronic equipment, and even dynamite to mountain-top sites of micro-wave relay stations. The H-34As (Sikorsky S-58s) delivered their cargo at the rate of 1½ tons every 2 minutes.

AROUND THE WORLD WITH SIKORSKY HELICOPTERS

LIFTING THE LANTERN—An HR2S-1 (Sikorsky S-56) from the Second Marine Aircraft Wing places a 1740-pound lantern atop a new 142-foot lighthouse at Cape Fear, N. C., with only 6 inches of clearance on the sides. Hovering stability for this difficult job was provided by Sikorsky's Automatic Stabilization Equipment in the HR2S-1.

52 RESCUED—The crew of the grounded French freighter *Pei-Ho* were flown ashore near Casablanca, Morocco, by an H-19 (Sikorsky S-55) of the Air Force's Air Rescue Service, which is on duty around the world. All 52 of the crew were rescued. The H-19 came from the U. S. base at Port Lyautey.

MORE S-58s FOR CHICAGO—The efficiency and convenience of helicopter shuttle service between Chicago's airports and the Loop area have meant vigorous growth for Chicago Helicopter Airways. The line has added two more Sikorsky S-58s to its fleet, for a total of five of these craft. The S-58 is the largest and most versatile helicopter in commercial service anywhere in the world.

SIKORSKY AIRCRAFT
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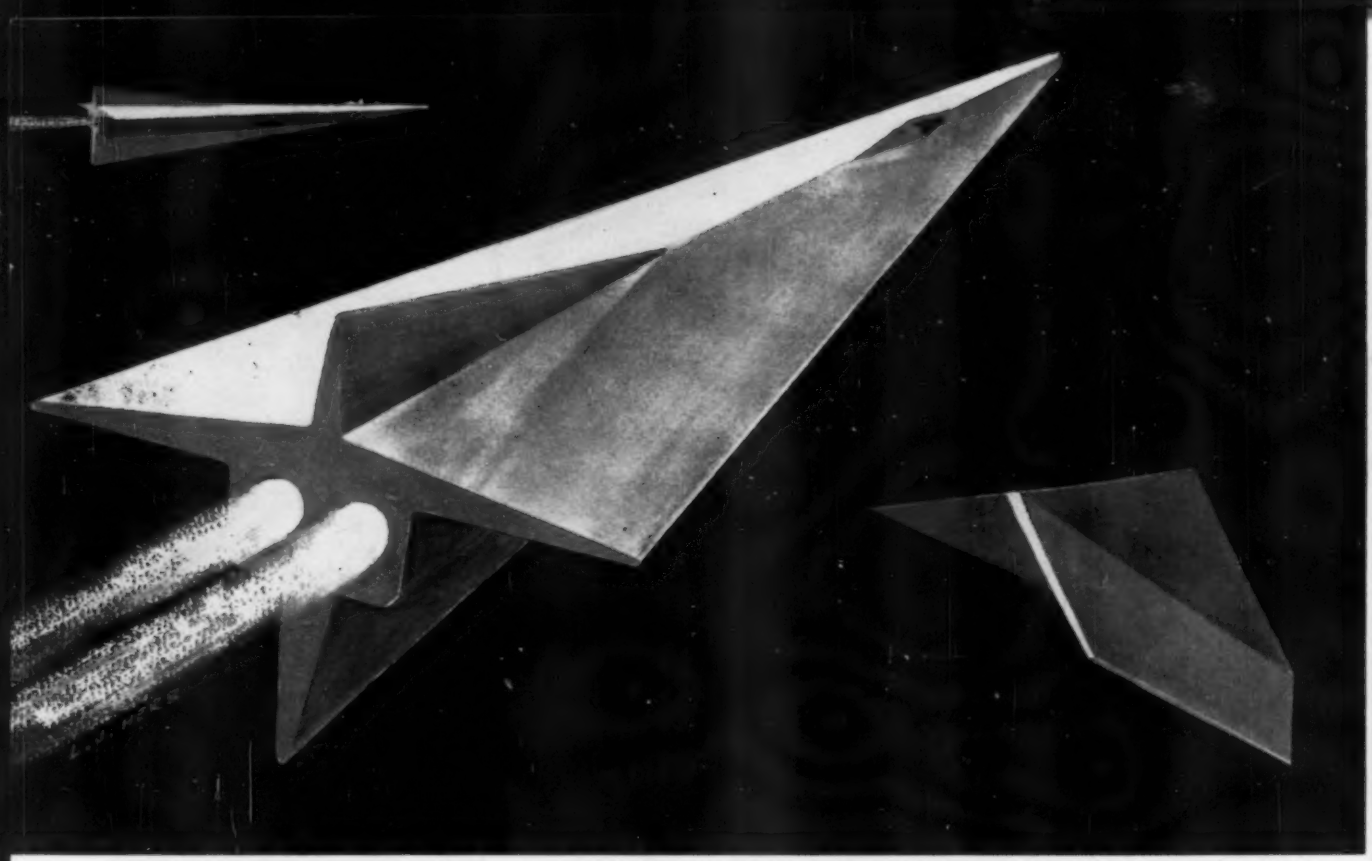


WEDGE SHAPED fuselage on this artist's conception of a high lift-drag ratio hypersonic aircraft creates a flow field which greatly increases lift by raising the positive pressure under the wing. This configuration is derived from the theoretical shape suggested by Antonio Ferri (lower right) in which the flow field from the fuselage covers the complete under surface of the wing. Landing and low speed flying would be problems on this type of aircraft. One answer to ease landing gear design might be to jettison part of the ventral fin before touchdown, as will be done with ventral fin of the North American X-15.

Radical Configurations May Find Role in

By J. S. Butz, Jr.

New York—Wedge shaped fuselages and biplane and triplane wing arrangements may be used at hypersonic speeds, as those that might be attained in re-entry from space, to raise lift-drag ratios to acceptable values.

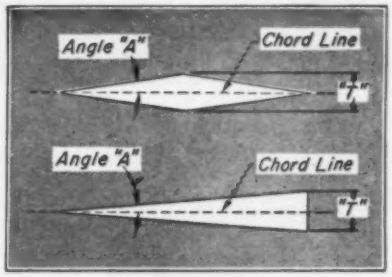
Drag of interfering supersonic flow fields, which can be countered up to Mach 2 by the area rule, becomes so critical in hypersonic flight that radical departures from current aircraft shapes may become necessary.

Ideal Forms

A large number of theoretically ideal aerodynamic forms are possible, but their actual usefulness will depend on how much they will have to be compromised in meeting the heating, structural, stability, and other requirements of hypersonic flying. They offer a starting point for strange-looking hypersonic and high supersonic aircraft proposals.

However, establishment of the overall validity of such proposals will have to wait until they are flown or until more complete design knowledge is available concerning behavior of structures at very high temperatures and the action of the atmosphere when pierced by a hypersonic body.

As all the answers to these basic questions will not be available for many years it is probable that the first vehicle capable of Mach 10 and better will resemble proven contemporary configurations to a great extent, but as knowledge and materials improve hypersonic aircraft could approach the aerodynamic ideal.

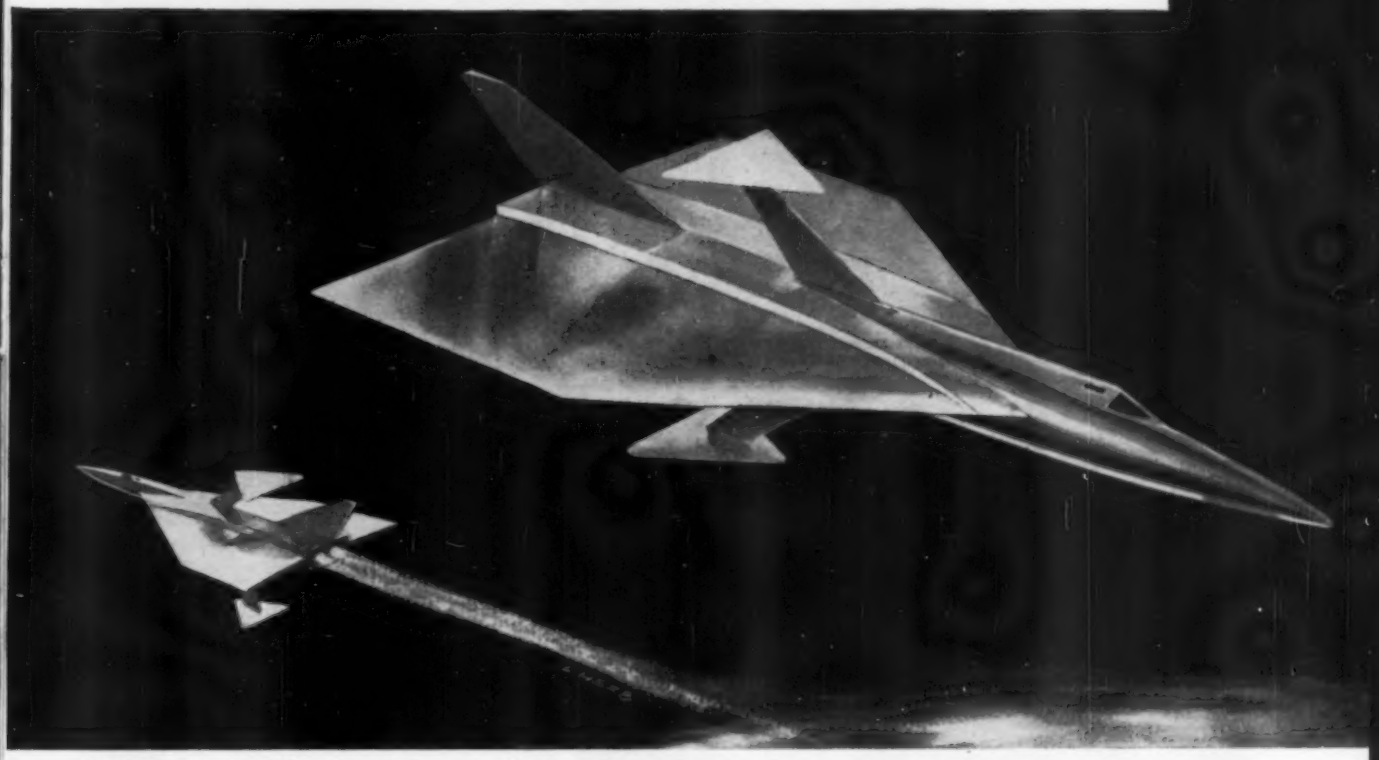


SMALL VALUE of angle (A) is necessary for low supersonic drag. Angle (A) and drag are both minimum for given length when maximum thickness is at trailing edge.

The success and economic feasibility of rocket powered boost glide aircraft and other man carrying hypersonic vehicles depends to a great extent on the basic drag reduction work now being conducted by government laboratories and private firms.

In contrast to similar subsonic work, wings and fuselages are rarely studied separately because the interference drag between two bodies in supersonic flow can easily double the drag of the bodies when considered alone. The bright point in the picture is that these interfering shock waves and flow fields can be arranged so that they cancel each other completely and theoretically reduce the wave drag due to thickness to zero.

Original suggestion that supersonic flow fields could be canceled and the thickness drag eliminated was made by A. Busemann at Rome in 1935, when comparatively few men were working on high-speed flow problems. Then



ARTIST'S conception of how a practical aircraft might use reflecting planes to reduce wave drag. Flow fields originating on the forward wing sections would be reflected against the rear surface and produce thrust. Movable pylons supporting the reflecting surfaces would automatically adjust with Mach number to keep the proper spacing between the surfaces and the aircraft.

Push Toward Space Flight

in 1937 C. Ferrari expanded Busemann's proposition to the three-dimensional case.

Today a large number of researchers are active in the U. S., some of whom have been studying the field since the Thirties. Prominent among these men are Antonio Ferri, who is now at the Polytechnic Institute of Brooklyn and R. T. Jones of the National Advisory Committee for Aeronautics. Others who have contributed significantly to drag reduction knowedge are R. T. Whitcomb with the transonic area rule, Max Heaslet and Harvard Lomax who worked with similar ideas around Mach 2, and A. J. Eggers, Jr., and H. J. Allen at even greater speeds. All these men are with the NACA.

Many contributions have also been made by industry. For instance, one of the most important mathematical tools used in high-speed studies today originated with W. D. Hayes in 1947 when he was with North American. Much aircraft company effort is directed toward reviewing and compiling the output of theoretical investigators.

The object is to present the information in the most practical manner for the aerodynamicist faced with the compromises of design work. A presentation of this kind that is rather widely referred to is the Douglas Aircraft Report No. SM-19181 by four authors headed by E. W. Graham.

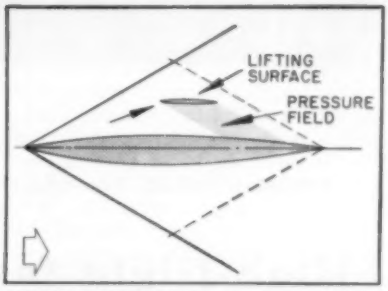
Mach 3 Wave Drag

Basically two approaches are being investigated to reduce wave drag above Mach 3:

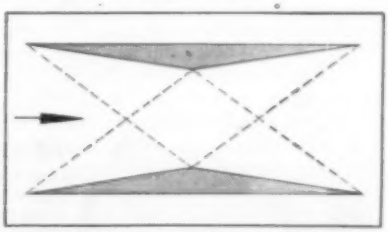
- **Contouring and arranging** the primary wing and body to produce favorable interference and pressure fields. (Area-rule no longer applies.)
- **Using auxiliary surfaces** to intercept shock waves and flow fields from the primary body. (Busemann principle.)

Probably the most exhaustive work publicly available on the principles involved in both of these methods has been written by Antonio Ferri.

Contouring and arranging a fuselage, wing and empennage for very high Mach numbers bears no resemblance to today's area rule. The aircraft's volume



FLOW INTERFERENCE can be created by surfaces and bodies placed in the envelope shown above. Envelope is created by turning the primary body around and drawing new Mach cone. Flat surface above generates lift because flow from primary body gives it an angle of attack. Surface also reflects flow onto the rear portion of the primary body giving it thrust.



BUSEMANN biplane theoretically has no wave drag due to thickness. Flow field from forward section of each wing is intercepted by the parallel rear section of the opposite wing. Pressure on all sections is then equal and there is no drag.

Tensile Properties vs. Temperature of Heat Treated Ti-155A

FROM ICARUS TO MACH NUMBERS:

High-flight fasteners have come a long way!

There's a good reason why today's high-flying missiles and aircraft don't suffer Icarus' embarrassing fate of coming apart at the seams. One explanation is in the remarkable high-temperature strength of the new heat-treatable titanium alloys.

Take Ti-155A for example. It has a density of only 0.163 pounds per cubic inch. Yet, at room temperature, tensile strengths are guaranteed to 170,000 psi, making it the highest-strength titanium metal commercially available. Even at 800°F, tensile strengths of this heat-treatable titanium alloy run well over 120,000 psi, while the creep rate at 50,000 psi and 650°F is only 0.000001 inches per inch per hour.

In addition to its high tensile strength, Ti-155A also offers good impact strength, ductility and fatigue characteristics. Its shop practices have been well established and Ti-155A can readily be forged to heavy reductions.

The result is an outstanding material for fasteners, forgings, extrusions, wire, rolled shapes—any place where a strong, light-weight, bar and forging stock is required. It's readily available in commercial quantities—at prices competitive with other vacuum-melted metals.

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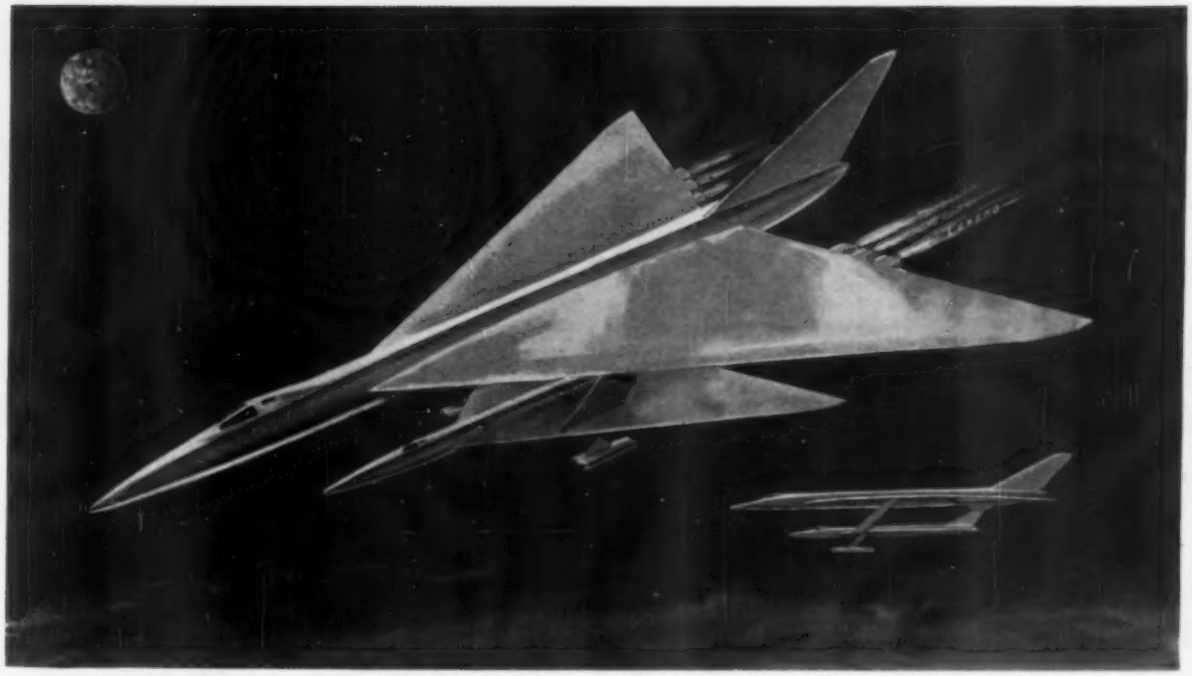


STAGED AIRCRAFT PROPOSAL made by Antonio Ferri is shown above in an artist's conception. Dr. Ferri believes that multi-stage aircraft using air-breathing engines will be more economical than rocket-powered boost-glide aircraft over great ranges. Large first-stage aircraft would accelerate the second vehicle with the payload to supersonic speed and a high altitude. The second stage would use ramjets and the first turbojets. Spacing between the stages would be optimized for best drag reduction at some speed below separation speed which would afford the quickest acceleration and smallest fuel load.

or cross-sectional area will reach a maximum near the tail, instead of around the center of the fuselage. The wing and body will both have blunt bases on trailing edges as shown by the work of Dean R. Chapman of the NACA.

He demonstrated that wings and bodies with the point of maximum thickness at the trailing edge had minimum drag at high Mach numbers. This is because supersonic wave drag is very sensitive to leading edge angle.

This leading edge angle for a wing of given chord or a body of given length is smallest when the point of maximum thickness is at the trailing edge. The wing therefore would be a wedge and the body of revolution would be a cone.

The base pressure drag of these blunt shapes was shown to be much smaller than the drag savings realized by the minimum leading edge angle.

Wedge Wing, Fuselage

In arranging such components for minimum drag, Ferri has suggested a wedge-shaped wing with a wedge fuselage completely below it. The theoretically ideal configuration of this type is in an accompanying sketch. In this arrangement pressure field created by the wedge fuselage acts over the entire surface of the flat plate wing and the configuration develops considerable lift when the wing is at zero angle of attack.

As this configuration was intended by Ferri to illustrate only the optimum fuselage for best pressure interference the other drawings in the picture are an artist's conception of how the idea might be modified to meet the heating, structural and stability requirements for hypersonic speeds.

It is not likely that anything resembling the drawings will be built very soon, but the principle is certain to be used on some of the more conventional Mach 3 aircraft now being built.

On these the fuselage might have a large bump under the wing which generates a flow field covering most of the lower surface. This would increase lift by raising the pressure under the wing. A smaller bump might be placed on the fuselage above the wing to create a positive pressure over the wing trailing edge.

This positive field would be enough to cancel the negative pressure which is normal on the upper trailing surface of symmetrical supersonic wing chord shapes.

Antisymmetrical Contouring

Ferri calls this type of fuselage shaping antisymmetrical contouring, and believes that it is superior to the normal area rule for lifting configurations. The area rule is designed to reduce the drag due to thickness and is symmetric in the vertical plane. Some area rule designers are quite definite in their insistence that the contouring should be symmetrical. On closer scrutiny the disagreement is not fundamental and usually arises because the starting assumptions are different or dissimilar configurations are being discussed.

The work that Ferri and others have done with pressure drag reduction is also intimately connected with reducing the drag due to lift. Better lift distribution and lower vortex drag also can be achieved through these fuselage-created pressure fields.

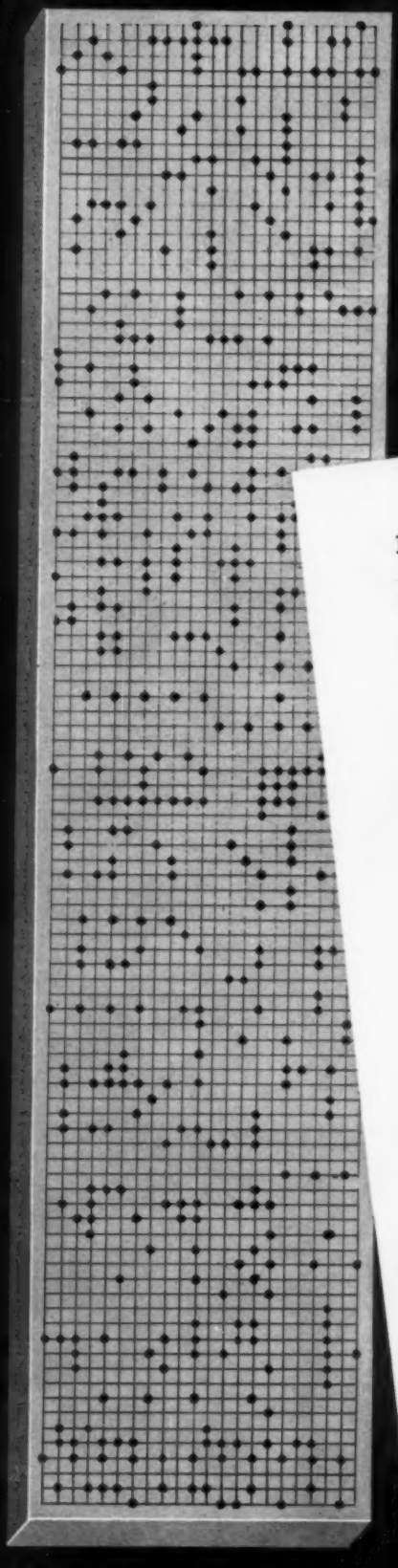
Properly placed pressure fields can have the same effect on wing flow as cambering, twisting and irregular planform shapes.

The second method of reducing wave drag at supersonic speeds, intercepting flow fields with auxiliary surfaces, will probably be the most difficult to use in practice. But it theoretically offers total drag reductions of greater than 50% even for efficient configurations.

The supersonic biplane proposed by Busemann illustrates the principle involved in all of this work. The bow shock wave off each asymmetrical airfoil is reflected back to the trailing edge. The flow field created by the inclined forward portion of each airfoil is intercepted by the rear portion of the opposite airfoil.

As the intercepting surface is inclined at the same angle as the originating surface the flow is stopped and no

Laboratory or Ground Support Equipment
for Missiles or Aircraft



Dots show a pattern of one phase
of test missile connections

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Pre-flight check-off of a missile required simultaneous connecting of 100 missile electrical circuits with 22 test instrument circuits, making a total of 2,200 connection points. It was further necessary to inter-connect these circuits in a rapidly-successive series of combinations. The small number of units required would not warrant expensive tooling for a precision rigid-pin device.

SOLUTION

Cole Electric Co. designed a switch to perform this complicated function that is fully automatic including the sequencing of circuit-selector boards. It is made possible by Cole's self-aligning contact pins which can be sealed and allow for wide tolerances in the layout of the grid, yet provide positive, dependable connections.

The principles incorporated in this device are applicable to a number of specialized switching problems. Inquiries from qualified aircraft and missile manufacturers are invited.

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reflection occurs. The pressure on the two surfaces is also equal so there is no imbalance of pressure forces and no drag.

The practical application of this principle to three-dimensional wings, which is being studied by Ferri and others, is best visualized by placing a flat surface through the points where the shock waves intersect midway between the wings and then remove the upper wing. Now the flow from the forward position of the wing is reflected to the rear section and the pressure drag is again zero.

Efficiency Limited

The most serious difficulty with the Busemann biplane idea is that it will operate efficiently at only one Mach number. For any given speed the distance between the wings or the wing and the reflecting surface must be held precisely or choking may occur and drag greatly increased because air begins to spill over the outside of the wings.

The accompanying drawings are an artist's conception of how reflecting surfaces might possibly be put to practical use. The small reflecting planes above and below the wing are mounted on a pylon which is automatically adjusted with Mach number to maintain the proper spacing.

Some proposals have included only a reflecting surface under the wing in a biplane arrangement and the wing would probably be flat on top. High positive pressure created on the aft portion of the wing by this lower surface adds to lift and decreased drag. The surface above the wing in the triplane version would reduce wave drag even further but would counteract the lift generated by the lower plane if the wing and reflecting surfaces were vertically symmetrical.

Problem Areas

Main problems connected with operating these reflecting surfaces are the structural one of supporting the very thin structure with a thin pylon, the mechanical one of automatically maintaining the proper gap and the frictional drag problem which is aggravated by increasing the wetted area of the aircraft through the addition of the reflecting planes and pylons.

It has also been pointed out that lowering the interference drag and wave drag due to thickness has a beneficial effect on the wave drag and vortex drag due to lift and the skin friction drag.

A wide number of configurations are theoretically possible which could have very low wave drag through judicious placement of the aircraft components and reflecting surfaces. Nacelles, external stores and other bodies can be placed so that favorable interference will eliminate their drag due to thickness.

Recently Antonio Ferri proposed that small aircraft be carried below a mother plane so that flow field cancellation between the two would virtually eliminate the wave drag of the smaller. Ferri made the suggestion after a recent Wright Brothers dinner when he was asked to comment on a lecture given by H. Julian Allen. He disagreed with Mr. Allen's belief that rocket-powered boost-glide vehicles would be more economical for long-range flight than aircraft using continuous power developed by air-breathing engines. Ferri contended that this would not be true if consideration was given to staging the aircraft as the glide vehicles would do by dropping away the rocket boosters. The first stage on the air-breathing system, the mother plane, could return to its takeoff point as soon as it accelerated the smaller ship with the payload up to flight speed and altitudes.

A type of wing which seems to be ideal for spreading out the volume of an aircraft so that favorable interference fields might be created is the M or W wing suggested by the NACA. Location of large bodies such as nacelles at the wing juncture where the sweep changes would allow flow-disturbing contouring to be placed relatively close to the wing flow field that would be influenced, and thus increase the effectiveness of the drag reduction modification.

Laboratory to Study Effects of Re-Entry

Aeronutronic Systems, Inc., Glendale, Calif., has been awarded an experimental contract relating to intercontinental ballistic missile re-entry, by Ballistic Missiles Division of Air Research and Development Command. Study involves gas interactions with the surface of the missile nose. Experimental work under the contract will be done at Aeronutronic's Newport, Calif., new site in an aerothermo-chemical laboratory and test cell which are already under construction.

High-Speed Treads Set for Boeing 707

Boeing 707 jet transport will mount tires capable of withstanding landing and takeoff speeds up to 200 mph. Developed by the Firestone Tire & Rubber Co., the high-speed tires are said to have successfully passed the fastest qualification tests ever required of commercial aircraft tires.

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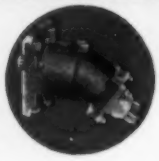

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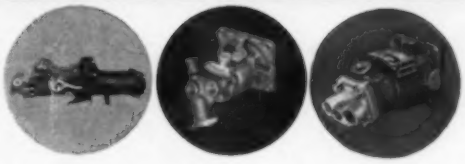

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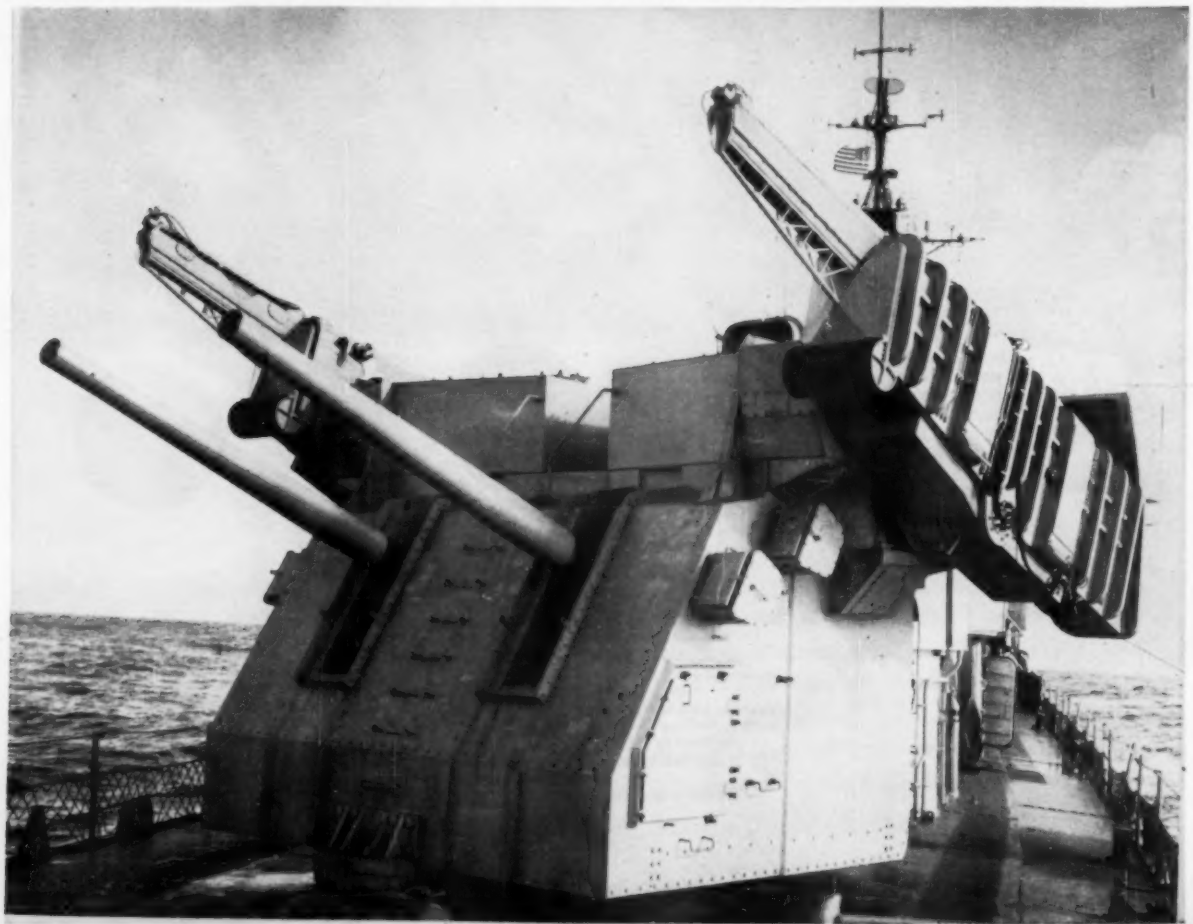
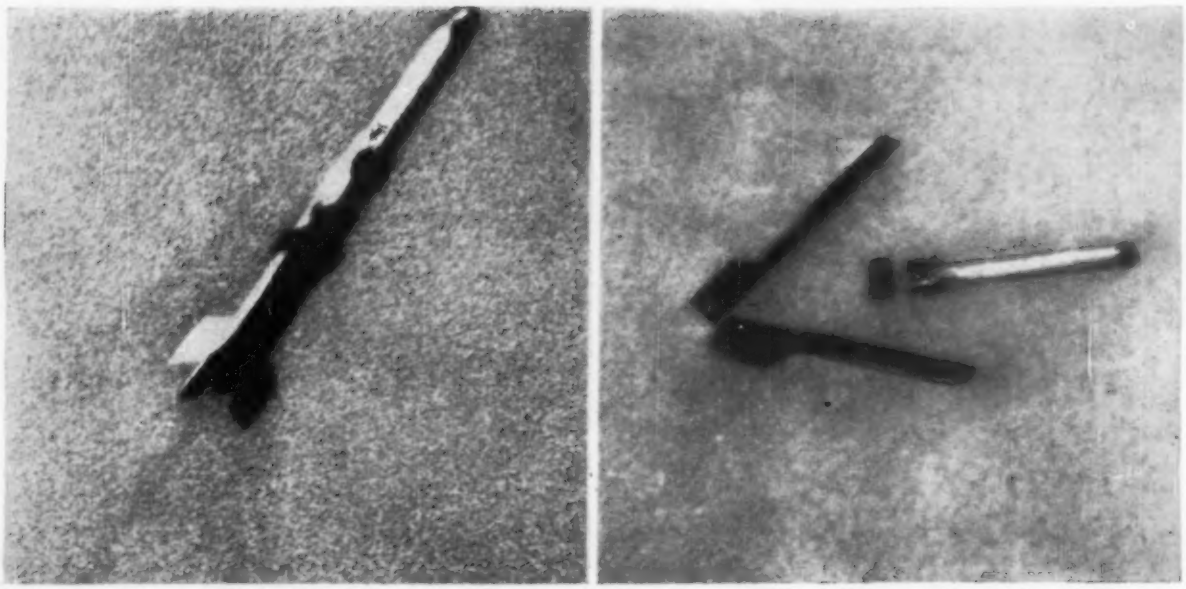
Rocket-powered weapon is launched from destroyer after interlocking fire control system has utilized data from ship's sonar gear.

Destroyer Fires Rocket-Boost Torpedo

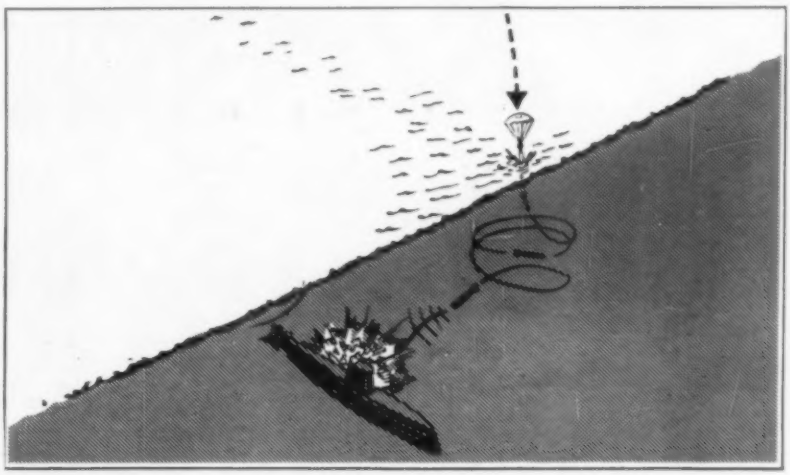
Destroyer 5-in. gun mount is launch platform for RAT (rocket-assisted torpedo). Weapon can be used on most U. S. destroyers.



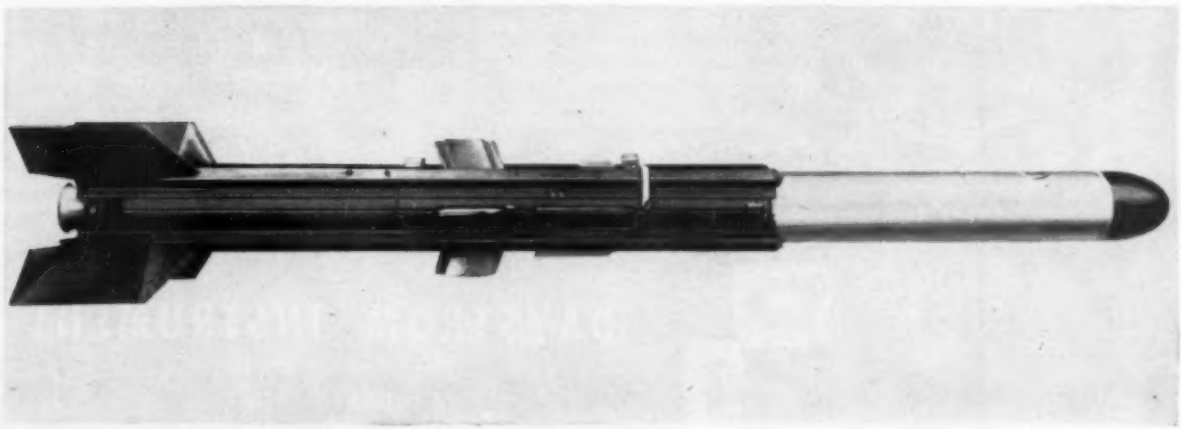


Long-range camera stops RAT in flight (left), shows airframe separating from the torpedo (right). Sheet-metal frame is loosed when straps are blown off at proper place in flight by pre-set timing device. Missile's range is several miles.

Pasadena—Rocket engine drives a lightweight acoustic-homing torpedo developed by Naval Ordnance Test Station at China Lake, Calif., and now on operational status with fleet units. Designated RAT (rocket-assisted anti-submarine weapon), device allows surface vessel to wage submarine warfare from a distance, without leaving assigned station. Navy says RAT can be installed on any surface ship having standard 5-in. anti-aircraft gun mounts, but emphasis is on destroyer use (AW Feb. 17, p. 32). After launching, RAT flies to target area where airframe is separated from torpedo. Weapon then is lowered to water by parachute, homes on target. Rocket engine uses solid-propellant fuel. A fire control system uses analog computer which programs missile flight, utilizing ship's sonar data.



Drawing shows RAT settling into water after deceleration by parachute, then homing on submarine (above). Drawing below shows airframe vanes, straps.



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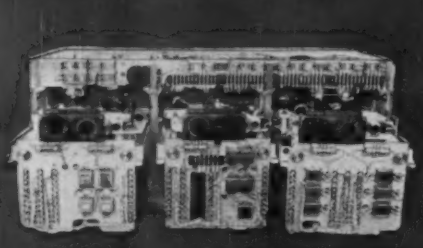

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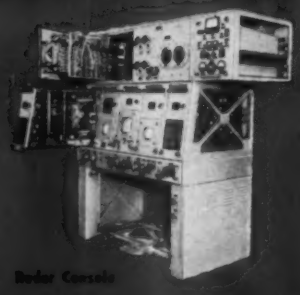

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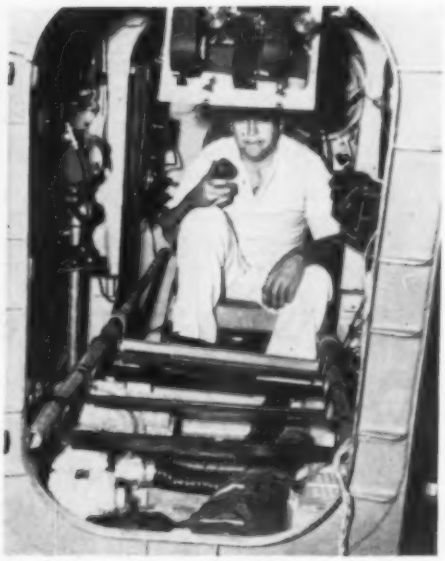

SPACE cubicle instruments (left) control blowers, television set, communications. At right, subject peers under movie recording cameras.

Farrell Ordeal Valuable Space Test

San Antonio—Volunteer Airman Donald G. Farrell, in a space flight experiment at the Air Force School of Aviation Medicine, spent seven days in a completely sealed test chamber living in an environment maintained at a simulated altitude of 18,000 ft. Temperature was kept at about 75 deg., and humidity averaged 50%.

Farrell emerged from the experiment in apparent good health and good spirits. Although signs of fatigue appeared in his handling of problems Thursday night and Friday, there was no psychological breakdown. No actual findings will be reported until the Aero Medical Assn. meeting Mar. 24-26 in Washington, D.C.

Although the experimental space cabin was sealed and self-contained during the week long test, the unit's water recirculation system was not used. Farrell carried his fresh water in the cabin, and liquid and solid wastes were stored in sealed containers.

Farrell had a week's supply of food with him. There was no refrigeration, so no fresh food could be used. Food was of a type generally available in cans and other containers. He was not on emergency type rations.

Air in the cabin was dehumidified, and oxygen was added as needed. Carbon dioxide was eliminated by a baralyme absorbent.

Farrell lived and worked in a 28 hr. day which was broken down into two 14 hr. cycles. This cycle included two four hour work periods, a four hour period for sleep, an hour and a half for relaxation and a half hour hygiene, exercise and similar purposes.

In the work periods, Farrell solved problems on a console which was equipped with lights and switches. Cabin was also equipped with a portable TV screen on which other problems were flashed to him.

Generally, Farrell was confined in a fairly pleasant environment in terms of temperature, humidity, nourishment. The experiment was aimed at finding his particular reactions to confinement in these conditions under the work cycle imposed. Since all people react differently, findings will be qualified by the fact that they pertain specifically only to Farrell.

The Farrell experiment provided a valuable test for the space cabin equipment. Further tests of similar duration and other for shorter periods are planned, although a definite schedule hasn't been established. Testing with this simulation gear will continue even after manned space flight has been accomplished.

The Farrell test will also provide valuable material for planning of the vital work-speed cycles for space crews.

Space Programs Pace Navy Weapon Trends

Washington—Future Navy weapon trends will include space programs, greater use of the weapon system concept and greater coordination among bureaus under the new "lead bureau" system, Rear Admiral F. S. Withington, outgoing chief of the Bureau of Ordnance said last week.

Adm. Withington also suggested five ways to attack "an equation which goes like this—higher performance equals greater complexity plus greater cost plus more acute maintenance problems." They are:

- **Ingenuity and sound thinking** in the initial engineering concept.
- **More realistic specifications.**
- **Cost-conscious engineering.**
- **Value engineering**—The use whenever possible of standard stock items.
- **Reduction in the number** of actual hardware developments, and missile growth programs.

Adm. Withington will be replaced by Rear Adm. Paul D. Stroop, now on duty with the Taiwan Patrol Force. Adm. Stroop was deputy and assistant chief of the Bureau of Ordnance from late 1954 until early 1957. He also is a former commander of the Naval Ordnance Test Station, China Lake, Calif., and former senior Navy member of the Weapon Systems Evaluation Group.

Adm. Withington, speaking at an American Ordnance Assn. meeting here, gave a number of "generally optimistic" predictions on Navy weapon trends, including:

- **Trend toward weapon** system development will continue, and there will be fewer developments.
- **Integration and coordination** of development effort in cases where more than one bureau is involved, will continue to improve under the newly established "lead bureau" system.
- **Bureau of Ordnance will** continue to decentralize the direction of development projects to its laboratories.
- **"Within the framework** of a national program the Navy will play an important role in satellite and related developments."

Adm. Withington also added his voice to the widespread criticism that "there are currently far too many committees and reviewing authorities."

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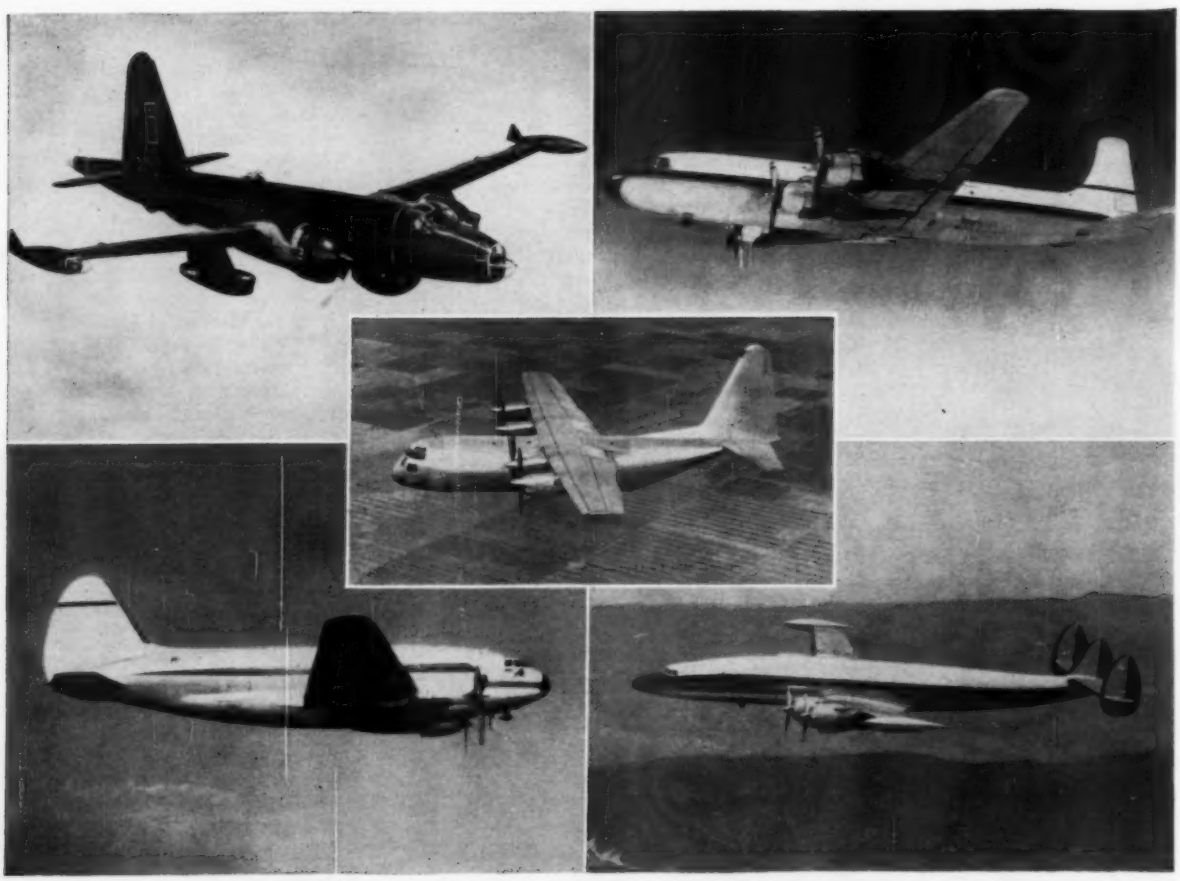


Fenwal CONTROLS TEMPERATURE . . . PRECISELY

French Full Pressure Suit Has Capability for Use in Space

Paris—Full pressure suit under development by French air force physiological technicians has equivalent capabilities to U. S. designs.

Research and development at Bretigny, French air force flight test center south of Paris, closely follows USAF results.

Recent tests indicate that the French have full pressure suit prototypes which are capable of protecting man in space flight.

However, lack of funds and skilled personnel are holding back progress.

Full pressure suit in completed form is not expected before middle of 1959 or early 1960, according to Dr. Jean Colin, French air force director of physiological studies on flying suits.

One prototype full pressure suit resembles USAF's new lightweight full pressure suit (AW Dec. 9, p. 29). Biggest difficulty is with helmet design, which is a series of compromises. Unlike U. S. suit, pilot cannot don complete outfit by himself and must rely on ground personnel. Pilot can possibly undress alone. Complete donning time runs about 10-15 min.

Helmet is attached by use of one ball-bearing race and one slip-ring around neck area. Helmet tie-down is achieved with nylon straps at each side of slip-ring and attached to shoulder of suit.

Two visors are provided, one sun-visor type and other as face-plate visor. Face visor is opened and closed by pilot and is normally closed most of the time. Both face and sun visors are articulated on hinge points at the ear points. Face visor seals in latex rubber gasket and opens upward over pilot's head.

Field of vision extends past limits of side vision and equals 180 deg. Face plate visor also is equipped with fine wire heating elements to eliminate fogging.

Acoustic values are not as good as French would like, but problem is expected to be resolved soon. Microphone is integral part of helmet as well as ear phones, with the former placed in front and lower than pilot's lips.

Exterior of helmet is layer-bonded plastic and interior contains padding for crash protection. French tried fish-bowl type helmet a few years ago, but rejected it primarily due to lack of crash protection.

Present helmet weight is considered much too heavy, approximately 7½ lb., with no immediate hopes of alleviation.

Wiring for communication and defogging elements exits to left under chin.

Oxygen supply is located at rear of pilot's head. Exhaust valve is located at left rear, indicating attempts at rotational oxygen flow within the helmet. Helmet configuration appears to allow greater head movement compared to USAF's latest published version of full pressure suit.

Suit itself is composed of three layers: outside is nylon-cotton, middle layer is rubberized airtight fabric and extends up to neck seal, and third layer, on the interior, is almost identical with that of the second but contains holes about one inch apart over entire surface for ventilation purposes. Unique feature of suit is continuation of costume to toes, with ordinary boots worn as foot covering.

Electric heating is integrated in ventilating layer. Leather gloves lined with silk and rubberized intermediate layer are worn over the sealed wrists of the suit.

FRENCH AIR FORCE high altitude partial pressure suit is on operational status. Maximum altitude permissible is 100,000 ft. Similar to American T-1, dummy model shows capstan bladders on legs and arms and oxygen hook-up to face visor. Zippers across shoulders and down inside calfs of legs permit donning suit in minimum of time. T-coupling at chest has covered hose connection leading to chest bladder. Anti-G pressure connection for stomach and legs is hidden on dummy pilot's left side while dangling hose visible just behind plastic chair is for oxygen supply. Black material under armpits is elastic panel for free arm movements. Boots are standard flight equipment while gloves shown have been improved to include pressure bladder over back of hand extending to finger tips. Long underwear is worn under nylon-cotton suit and extends to wrists, neck and ankles.

Full pressure suit studies have been designed to fit most French high-altitude aircraft ejection seats. In overwater bailout, suit would float pilot after separation from chair. Emergency oxygen supply after bail-out has been provided, but studies are incomplete. Total weight of helmet and suit is unknown, but would probably be around 16 lb. without boots and other equipment.

Various combinations are being tested with a view toward obtaining a pressure "capsule" in the suit allowing pilot good freedom of movement and relative comfort. As yet no French full pressure suit has reached operational stage.

Defense Management Shortcomings Cited

Dallas—Defense effort should be reorganized under more efficient management principles and the power of Defense Department committees to hamper military programs should be curtailed, Brig. Gen. R. E. Galer, USMC (Ret.) told the Dallas Airpower Council recently.

Speaking at a briefing of Dallas businessmen on missile programs, Galer also criticized the use of interservice rivalry as a "whipping boy" for shortcomings in the U. S. defense effort.

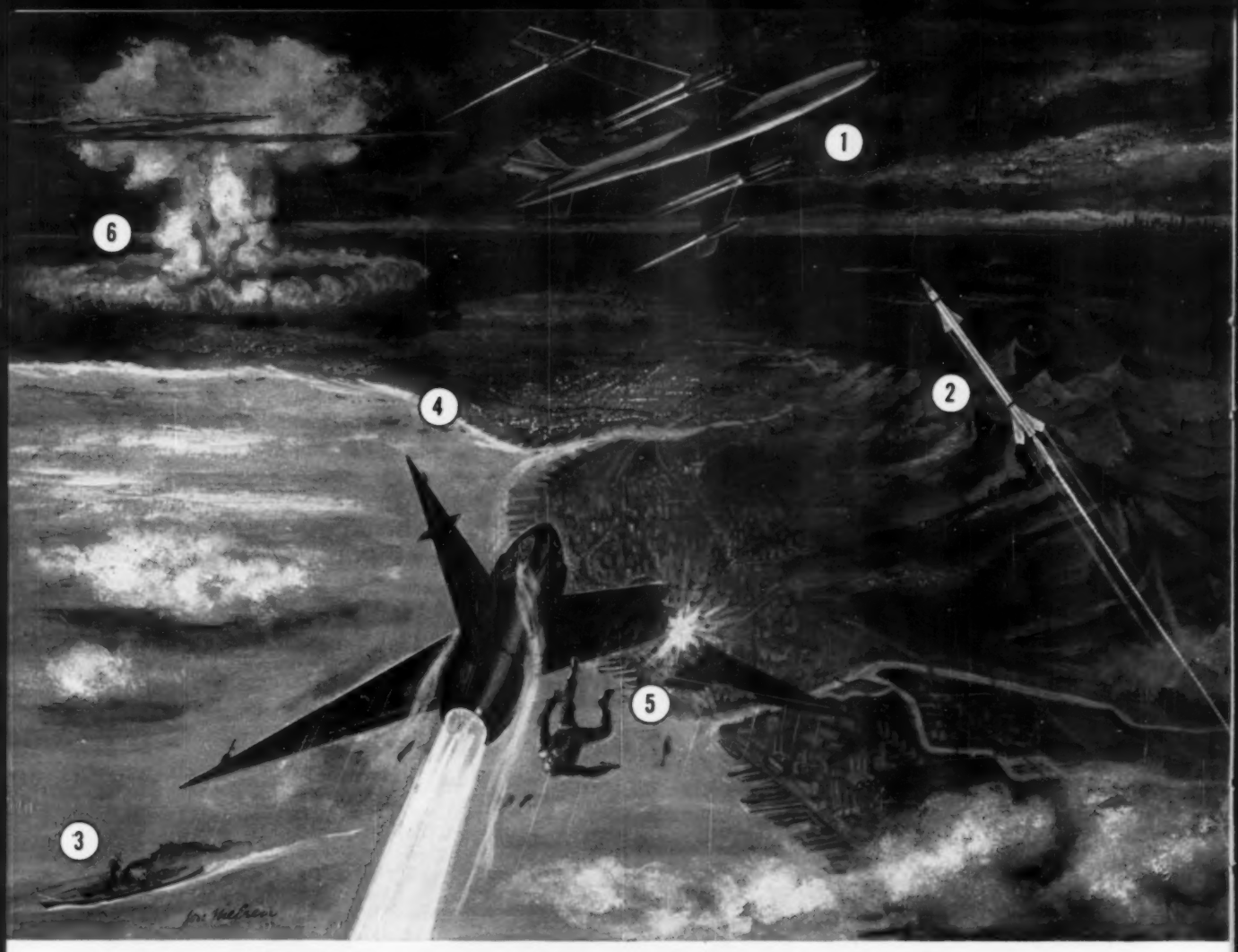
Galer is manager of engineering programs for Temco Aircraft Corp. and was formerly head of the Navy Bureau of Aeronautics' Guided Missile Division.

Galer made these three recommendations for improving the defense program:

- **Return congressmen and senators** to passing necessary legislation, rather than having them attempt to become experts on military strategy or scientific developments.
- **Reduce drastically** the size of the Department of Defense so its officials will stop trying to be scientists and military strategists and will stick to their management functions.
- **Return budgeting,** and comptrolling experts to staff functions rather than permitting them to act as an executive agency.

Galer criticized the "labyrinth of committees, bureaus and echelons of government which have to be convinced individually that each step must be taken and which, if they do not have the authority to approve or disapprove a project, are usually in a position to pigeonhole, delay and harass."

Concept of budgeting a five or 10 year program on a one year basis, then auditing the funds as many as three times before they are spent, was termed ridiculous. "If it were only ridiculous, we might live with it, but gentlemen,



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it is increasing the cost of operation a whole order of magnitude," Galer said.

The Temco official pointed out the irony in a Navy award to a top scientist at Naval Ordnance Test Station for development of the Sidewinder infrared-guided missile.

Galer said the missile was developed in spite of repeated failure to secure funding "from the technical-strategists in the Department of Defense and Bureau of the Budget." He said the job was done with "black market" research and development funds milked from other programs.

Galer also observed that many congressional and Defense Department figures now calling for increased military efforts were cutting the budget, reducing the strength of the armed services and blocking long-range space programs a year ago.

Dallas group was advised to examine the record of outspoken leaders who are calling for a stop to "interservice squabbles that have held up the missile programs." Galer said service competition is being used as a whipping boy and should be thoroughly scrutinized. He said something is very strange when two similar missiles like Atlas and Titan are considered a good example of backup to insure performance, and Jupiter and Thor are called horrible duplications.

"Somehow this logic leaves me rather confused," Galer said.

LIQUID fluorine is transferred under pressure of helium gas in this tank truck.

Tank Truck Hauls Liquid Fluorine In 5,000-lb. Units Cross-Country

First tank truck designed to carry commercial shipments of liquid fluorine cross-country is now in operation.

Owned by the General Chemical Division of Allied Chemical & Dye Corp., the truck has been carrying 5,000-lb. units of liquid fluorine on a regularly scheduled basis from General's plant in Baton Rouge, La., to "consumers from New York to Calif." Of these consumers, Bell Aircraft Corp. in Buffalo and Rocketdyne Division of North American Aviation, Inc. in Canoga Park are, perhaps, the two most important.

Both companies are test firing prototype rocket engines which use liquid fluorine as the oxidizer.

The fluorine shipping unit, built by Air Products, Inc., is actually three tanks, one inside the other. The innermost tank, made of Monel, carries the liquid fluorine. It is surrounded by a stainless steel tank filled with the liquid nitrogen refrigerant. The third and outermost envelope is constructed of a mild steel, carries a granulated insulating material and is under vacuum. The fluorine is transferred under pressure of helium gas.

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Ready, willing and able to meet the needs of the aviation industry—that's "Johnny-On-The-Spot," Air Associates' new trade figure.

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Interceptor Cockpit Test Model

Possible configuration for a future cockpit for a 2-engine interceptor-type aircraft was unveiled by Lear, Inc., at recent symposium in Dayton, Ohio. Configuration was developed under Lear's contract with WADC, is not necessarily a configuration per se, rather tests number of ideas. Notable change is flight control stick at far right, which twists clockwise and counterclockwise to give yaw control and replace rudder pedals. Engine gages make use of analog computer to give engine command data as well as actual condition information, with provisions for direct readings in case of computer failure. Central part of display is extension of WADC phase II panel with substitution of full three-axis freedom for attitude sphere, making azimuth readable on same instrument as pitch and roll. This display will be for next generation of USAF weapon systems, succeeding the phase II panel which is incorporated into production F-105 and F-106 aircraft.

PRODUCTION BRIEFING

Sundstrand Machine Tool Co., Denver, Colo., has purchased the American Machine and Foundry Co.'s Turbo Division at Pacoima, Calif. Turbo, a leading producer of auxiliary power units for missiles, will now operate as the Sundstrand-Turbo Division of the Sundstrand Machine Tool Co.

Santa Fe Western Corp., Albuquerque, N. M., has acquired controlling interest in Titanium Fabricators Inc., Burbank, Calif., and will assist in directing management of the firm. Missile manufacturers are reportedly interested in the Burbank company's line of titanium pressure vessels, which are produced by hot-spinning techniques.

Aeronca Manufacturing Corp., Middletown, Ohio, has placed its Research Division at Baltimore, Md., under the control of its director of engineering in an effort to coordinate more closely the engineering activities at the two places. Research Division is now designated the Baltimore Facility.

Atlantic Research Corp., Alexandria, Va., reports installation of high temperature (6,000F) spray coating equipment for coating with ceramic and metallic films. Coating thicknesses from .005 to .025 in. may be applied with the equipment.

Correction

Noting that design stress levels in the skin used on de Havilland Aircraft Co.'s Comet turbojet transport fuselage have been so reduced that the structure should remain free from fatigue cracks over a period six times its commercial life, AVIATION WEEK reported ". . . should a crack be imposed by service damage, it could be expected to spread slowly—at no more than ⅛ in. per flight cycle." (AW Jan. 13, p. 96.) De Havilland reports this statement should have read ". . . should a crack be imposed by service damage, it could be expected to spread slowly. Crack propagation tests show that when a crack of up to 3 in. is introduced by service damage, 2,000 pressure cycles—the equivalent of 6,000 flying hours—could be applied before it spread at a rate of 0.1 in. per load cycle."

PUMP PRIMERS

by
Arthur A. Nichols

Gerotor pumps as a power source for hydraulic servo systems

Some interesting new applications for Gerotor pumps have been developed in recent times involving specialized problems in hydraulic servo systems.

One of these problems took us into marine service where a new type of anti-roll fin was developed for a large ship. This stabilizer is a ponderous affair and its positioning in response to the condition of the sea has to be prompt, smooth, and positive. To do this job, the marine engineers developed a hydraulic servo system and a Gerotor pump was selected to work with the sensing elements to provide control power to the main actuator. Other applications of a similar nature have been made in the steering systems of battleships and other heavy vessels and the positioning of hydraulic pistons in other types of service. Our experience in servo work of this type is yours for the asking.

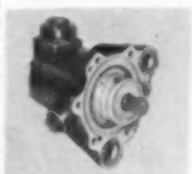

Fig. 1. Multiple element pump

Important advantages are offered by the Gerotor pump for servo control applications. It is a positive displacement pump and provides a smooth power flow from one end of the pumping cycle to the other. Unlike other types of pumps which tend to quit work at the low end of the speed range, *Gerotors stay right on the job and provide positive power to the extremely low range.* Thus, they are exceptionally responsive in servo systems.

The Gerotor pump is a form of internal gear pump—simple and compact in basic design, (has only two moving parts). It is lightweight, valveless, provides exceptional performance and has low wear over a long service life. In addition it is balanced and extremely quiet in operation.

Common applications for Gerotor pumps lie in the range of pressures up to 1000 psi. They are suitable for low pressure hydraulic and servo systems, hydraulic motors, lube, scavenge and booster service, electronic coolant pumping in aircraft and guided missiles, and similar installations.

Technical information plus complete custom engineering and precision manufacturing facilities are available to help you obtain the *right* pump to meet your performance specifications, operational requirements, envelope configuration and optimum plumbing. Your inquiry is invited.

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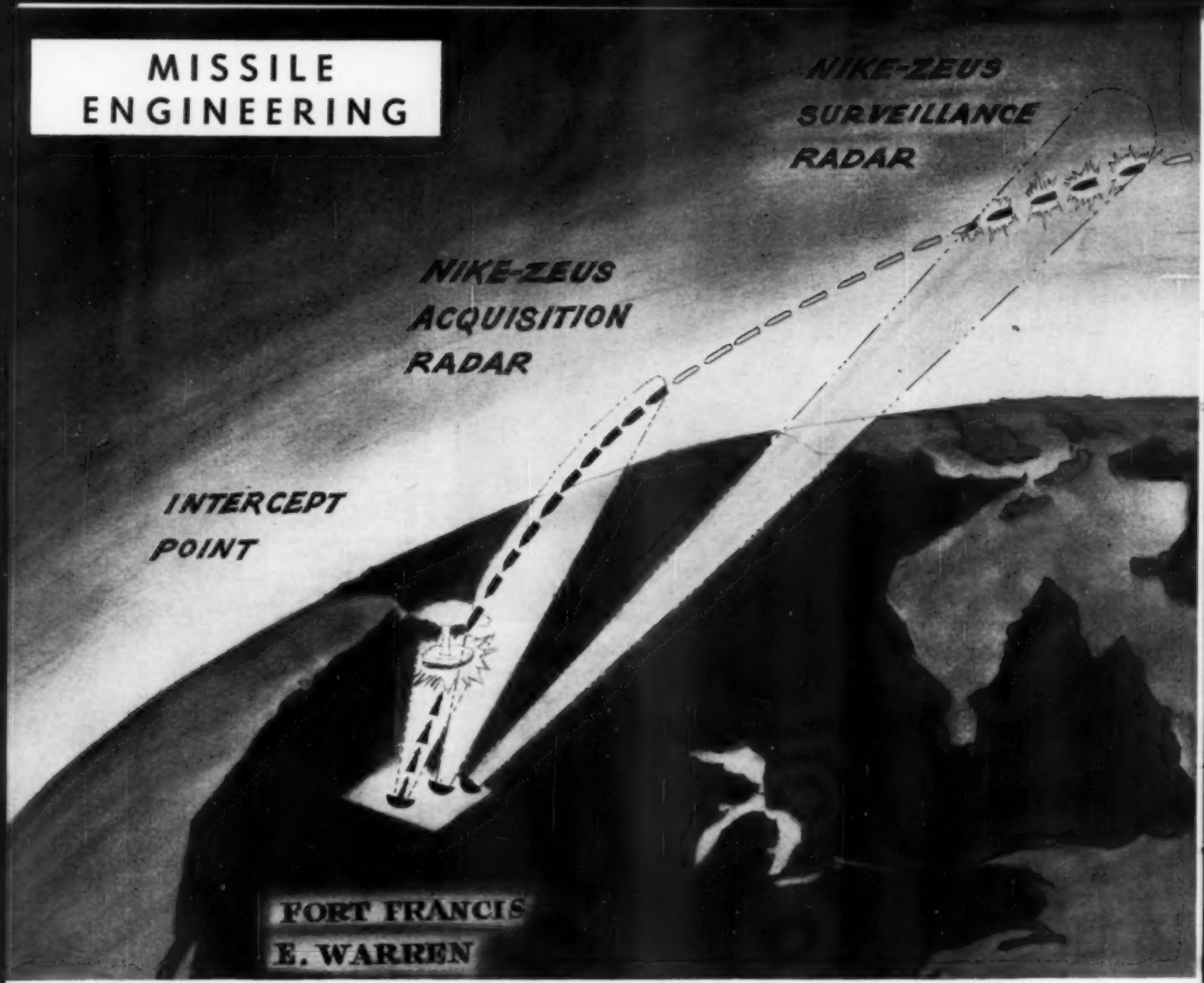
MISSILE ENGINEERING



SOVIET ICBM aimed to strike USAF's first ICBM launching sites at Ft. Warren, Wyoming, would be detected and tracked by . . .

USAF, Army Wage Battle for Control of

By James A. Fusca

Competition between Army and Air Force over which service is to develop and operate U. S. missile defense systems is growing steadily more intense. Army is fighting for operational responsibility for the Nike-Zeus anti-missile missile system which it has been assigned to develop. USAF claims Nike-Zeus is unsophisticated and inadequate in comparison with USAF's competing Wizard system.

Faults and virtues of both systems are being discussed more and more freely as both services seek support from Administration leaders and on Capitol Hill.

Rivalry continues to increase despite decision last month by Defense Secretary Neil H. McElroy dividing responsibility, assigning Air Force to install a missile detection radar network in the Far North and Army to develop its Nike-Zeus system for installation here in the U. S.

Radar Sites

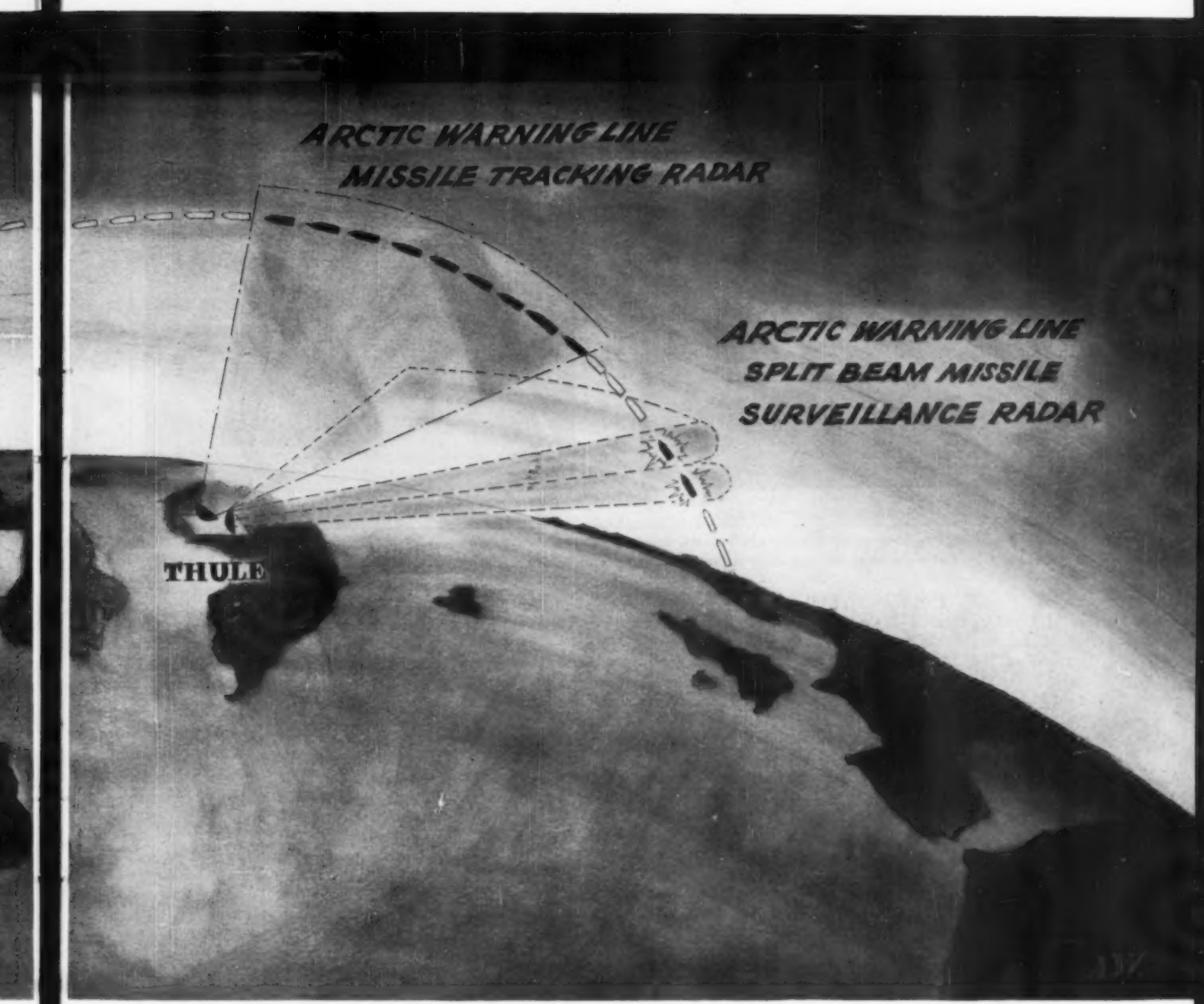
Missile detection radar sites making up the Arctic Warning Line and the Nike-Zeus program have been placed under the Defense Department's Advanced Research Projects Agency and its newly-appointed director Roy W. Johnson.

Following picture of the United States' planned missile defense program is emerging:

• **Arctic Warning Line.** Three long-range missile detection radar stations will be established in the Arctic: one in Fairbanks, Alaska, another in Thule, Greenland, and a third in another foreign territory. These radars will be capable of covering all of Russia. They are expected to be operational in 1960.

• **Nike-Zeus.** Apparently chosen because it was farther along than Wizard (some hardware exists for Nike-Zeus—none for Wizard), the Army system employs three radars to detect, acquire and track an incoming missile, a fourth radar to track the anti-missile missile. Army says under present budget allowances Nike-Zeus will be operational in 1964, but believes that on a crash basis with more money it could be ready in 1962.

• **Plato.** A third anti-missile missile system called Plato has been under development for the Army. Plato is designed as a relatively mobile system for defense of U. S. and allied field armies



two radars of Arctic Warning Line, Surveillance, Acquisition and Tracking radars of Nike-Zeus system under proposed missile defense plans.

Missile Defense Systems

and critical overseas installations against intermediate range ballistic missiles.

Most authorities in the missile defense field are emphatic in stating that no really successful defense against an ICBM or IRBM is possible with any of the proposed systems. Anticipated "kill probability" of these systems will be only about 25%. Our objective, they say, should be to install the most effective systems now available with the clear understanding that they are logistic investments for utilizing future advances in the field.*

Arctic Warning Line

At each of the three long-range missile detection radar stations that make up the Arctic Warning Line there will be two types of radar equipment. Both types of radar will be capable of detecting incoming missiles at ranges up to 3,000 mi., but their functions will be different.

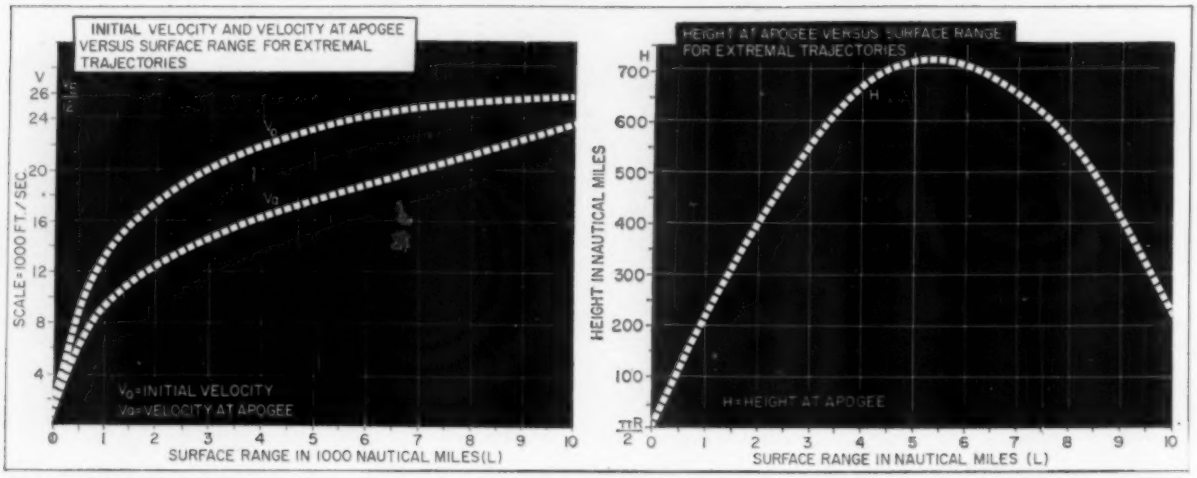
To detect Soviet-launched ICBMs at the earliest possible moment, each site will have a surveillance radar continuously exploring an assigned sector of the airspace high over Russia. These sectors will cover an angle of about 45 deg. so that all three radars combined will provide continuous and overlapping coverage of the entire Russian land mass (AW Jan. 27, p. 26).

These surveillance radars are improved versions of the AN/FPS-17 radars being used to track test firings of Soviet missiles from a USAF-operated base in Turkey (AW Oct. 21, p. 26) and U.S. missile firings at White Sands, N. M., from a base in Laredo, Tex. One important difference, however, is that the newest radars use an entirely different antenna pattern.

AN/FPS-17 technique uses a wide-angle horizontally-oriented antenna pattern stepped vertically by a mechanical feed system. Because the function of the Far North surveillance radars will be to detect and provide rough trajectory data on incoming enemy missiles anywhere within their sectors, they must employ a different scanning system.

Split beams, vertically offset by a few degrees, will be swept back and forth horizontally at a very rapid rate by means of a pipe organ antenna feed system. From the azimuth angle of intersection by a missile, angular displacement between beam intersections and time of travel, a computer will determine roughly the intruder's trajectory.

The second type of radar at each Arctic Warning Line site will be simi-



PROBLEMS of intercepting long range missiles can be seen from charts showing velocities and height of apogee for extremal trajectories. While extremal trajectories are most efficient, they are not necessarily optimum for mission performance.

lar to the Lincoln Laboratory's Millstone Hill radar, located at Westford about 30 mi. north of Boston.

Purpose of the Millstone Hill type of radar will be twofold: to track the missile long enough to establish its identity as a missile on a ballistic trajectory and not an errant meteorite and, secondly, to obtain data for computing point of launch and point of impact.

This radar utilizes a parabolic antenna 84 ft. in diameter mounted on a 90 ft. tower. The reflector can be rotated through 360 deg. and elevated from the horizontal to zenith. Beamwidth is about 2 deg. Several types of antenna feed systems have been studied both for use in search and track operation.

Tracked Sputniks

Specially designed 11 ft. klystrons provide enormous power outputs that have enabled the radar to track missiles fired at Ft. Churchill, Canada, Cape Canaveral, Fla. (both over 1,000 mi. away), and Sputniks I and II (at ranges to 2,800 nautical miles) with a relatively simple receiver. Equipment did not track U.S. satellite for first two weeks after launching because facility was shut down for installation of an improved receiver.

Output of the radar transmitter is 100,000 watts average power. By conventional equations, calculated peak output is 10 megawatts, pulse length 400 microseconds, pulse repetition frequency 25 cps. and duty cycle 1%.

Because of their narrow beamwidths, Millstone Hill type radars will depend upon the rough trajectory information furnished by the surveillance radars to acquire their targets. Tracking data will be utilized by a special transistorized computer developed by Lincoln Laboratory to compute impact and launch points, which will be transmitted to Air Defense Command at Colorado Springs, Colo.

Radio Corp. of America has been awarded the prime contract for installation of the three sites that make up the Arctic Warning Line. Contract was awarded to RCA primarily because of missile defense studies performed in partnership with Convair Division of General Dynamics Corp. on USAF's Wizard project. USAF will supervise the contract.

General Electric Subsystems

RCA will manage the contract and provide the high-power transmitters for the radar systems, plus some of the data processing equipment. General Electric, the company that developed the AN/FPS-17, will build subsystems for the surveillance radars, including the receivers and the antennas.

Goodyear Aircraft will build the radar antenna pedestals, radomes, organ pipe antenna feeds and similar hardware. Sylvania Electric Products has received a contract for supplying most of the data processing equipment for the sites.

Total cost of this equipment and its installation is reported to be about $720 million. A separate contract has been awarded to Western Electric to provide the forward scatter communications links, similar to the White Alice System. This contract is said to total about $200 million.

Informed Washington officials have expressed concern over the ability of the Arctic Warning Line to realistically provide 15 min. warning of an ICBM attack. They doubt that anyone in authority in the government would be prepared to accept the responsibility for believing and acting upon such a warning without further confirmation.

In addition to the radar installation at Millstone Hill, which is for the specific purpose of studying problems in missile defense, there will be two other radars of the same type installed for related experimental and research work.

One Millstone Hill type system is being supplied to Canada where it will be installed and operated at Prince Albert, in Northern Saskatchewan, by scientists of the University of Saskatchewan with the assistance of Lincoln Laboratory personnel. Canada's Defense Research Board will finance the costs of operation.

One purpose of this installation will be study of meteorites and the aurora borealis by high power radar as part of the program of the International Geophysical Year.

As is true of satellites and other research in the upper atmosphere, results of these studies may provide important information on the problems of missile detection and tracking in the polar latitudes.

Eventually this radar will probably be integrated into the Arctic Warning Line as backup against saturation attacks. Communications and data processing equipment probably will be installed for future use.

Third Millstone Hill type radar is on Trinidad to track missiles fired from Cape Canaveral. Pro-left government factions reportedly are openly hostile to island's being used to help solve missile defense problems.

Other Warning Techniques

In addition to the warning of an ICBM attack that could be provided by the Arctic Warning Line, at least two U.S. companies are studying methods for detecting the launching of Soviet missiles from sites in this country. They are Stavid Engineering Inc. and Sylvania Electric Products.

Stavid will be studying its proposed technique under direction of the Office

of the Assistant Secretary of Defense for Research and Engineering. Technique is considered sufficiently promising so that Stavid has been directed to not submit other proposals to the military services nor supply information except by direction of the Assistant Secretary's Office, in an effort to keep the method under wraps.

Active Defense

Studies of missile defense systems began with the start of the German V-2 offensive against the port cities of London, Antwerp and Calais. These early approaches to the problem—among them General Electric's Project Thumper (MX-795)—concluded that defense against even as elementary a weapon as the V-2 was technically beyond reach.

As the missile art has developed, however, and longer range missiles such as the ICBM and IRBM have become a major threat, the problem of defense has, paradoxically, become easier.

The V-2 had a time of flight of about five minutes, an altitude at apogee (highest point) of about 60 mi., and a range capability of from 75 to about 100 mi. For an ICBM with a range capability of 5,500 mi., height at apogee (on an extremal range trajectory) would be about 730 mi. and time of flight about 33 min.

Improvements in missile range, therefore, have provided a many-fold increase in the potential reaction time of the defense system for it to detect, identify, acquire, track and intercept the intruder.

A second advantage for the defense is that increases in missile range provide a corresponding decrease in the sector of origin of the threat. For example, ICBMs launched from the most easterly and most westerly possible launching sites in the U. S. S. R. at a target in the U. S. would define a missile approach corridor only about 30 deg. wide. A surveillance radar located at the target capable of completely covering this corridor might be adequate for ICBM detection. It would provide no protection against sub-launched IRBMs.

Nike-Zeus

Present plans of the Defense Department call for installing Nike-Zeus defense systems to protect missile and bomber strike bases of the Strategic Air Command to preserve SAC's potential as a deterrent force.

System employs three types of radar:

• **Surveillance.** Upon warning of attack, surveillance radar continuously scans expected direction of attack out to ranges of 1,000 mi. Antenna is large Luneberg lens with rotating mechanical feed.

• **Acquisition.** As surveillance radar detects targets it assigns them to acquisition sets which lock onto and track targets long enough to obtain accurate trajectory data. Acquisition radars have range of 600 mi., also use large Luneberg lens antennas but with electronic steering.

• **Tracking.** Two 200 mi. tracking radars similar to the monopulse trackers for Nike-Zeus are employed with each Nike-Zeus battery.

One set, on assignment from an acquisition radar, will track the incoming target while the other set tracks the Nike-Zeus missile fired to intercept it. Both radars furnish continuous position data to a computer which has a limited ability to guide the Nike-Zeus missile to the intercept point by radio command.

Normally a complete Nike-Zeus installation will comprise one surveillance radar, two acquisition radars, each with four batteries of Nike-Zeus missiles with their associated tracking radars. For point defense problems, such as missile launching sites, the number of batteries will be varied to meet the requirements of the target.

For example, in the fairly near future the most probable target in the country to be attacked first will be an old Indian post just west of Cheyenne, Wyoming, called Ft. Francis E. Warren, where the Air Force is building its first ICBM launching sites.

These sites will be dispersed at distances from 10 to 20 mi. around the central living area, repair and supply depot. Here, probably one battery would be assigned to each site.

Coherent Detection

Receivers of the surveillance and acquisition systems use a type of coherent detection developed by Sidney Darlington of Bell Telephone Laboratories, called Chirp.

Chirp technique obtains coherent integration by use of a filter in the receiver which provides a linear phase shift versus frequency characteristic, the slope of which is equal to the length of the transmitted pulse. Theory is that all cycles of the carrier signal will add in phase at the output of the network. In this manner, the 500 microsecond pulse of the Chirp transmitter adds together for an output of about 5 microseconds.

According to some of the authorities in the field, the Chirp technique is not out of the research and development phases as yet. Additionally, strong claims have been made that the technique is unimaginative and basically incapable of discriminating between decoys and warheads.

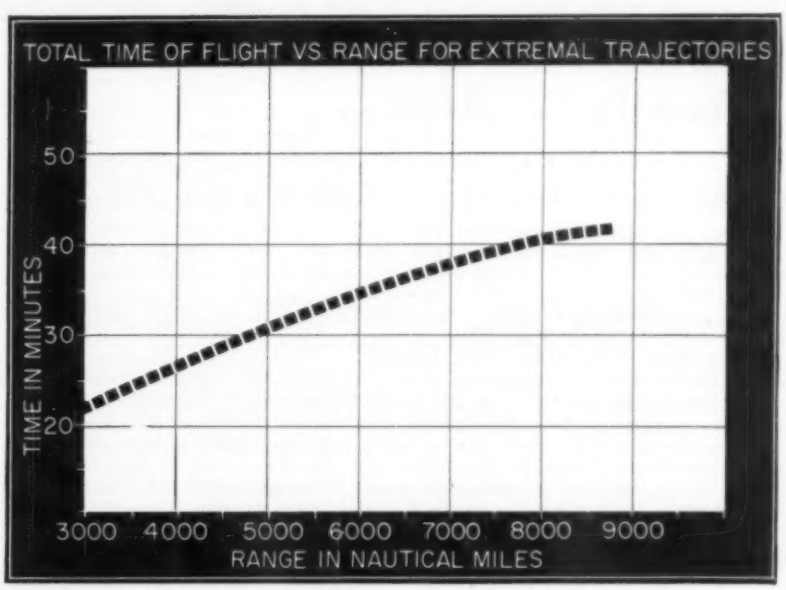
Bell Telephone Laboratories, on the other hand, is reported to discount the necessity for decoy discrimination. One Bell official has been quoted by military sources as saying that visionary things are fine but that Bell wished to work on things that were practical.

Contractors for Nike-Zeus are Western Electric (Bell Laboratories), Douglas Aircraft and Grand Central Rocket Co.

USAF's Wizard

Air Force has not surrendered hopes of developing its Wizard system, at least in competition with Nike-Zeus if not in place of it. Defense Secretary McElroy's memorandum to USAF last month, however, said USAF was to discontinue research and development on the missile entirely—although leeway was left for further radar development.

USAF officials say that the proposed



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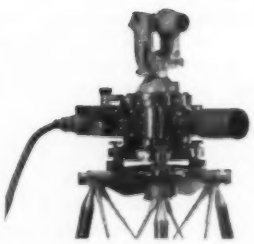
New P-E missile theodolites automatically align inertial guidance systems to within a few seconds of arc.

A new family of missile auto-theodolites has been developed by Perkin-Elmer to align inertial guidance systems with unprecedented accuracy. These theodolites are now operational at a number of missile sites and are being used in the production, testing and alignment of stable platforms.

P-E auto-theodolites monitor and automatically correct guidance equipment to within ±2 seconds of arc under day or night tactical conditions. They are available in short, medium and long-range instruments which operate from distances up to 1,500 feet. Although these auto-theodolites were developed for missile work, they are readily adaptable to a variety of non-military applications requiring highly accurate angular data.

These instruments are examples of Perkin-Elmer's ability to combine precision optics with electronic and mechanical systems. For regular information on Perkin-Elmer's design, engineering and production facilities, ask to receive OPTICS PLUS, our new quarterly publication. Write us at 770 Main Avenue, Norwalk, Conn.



Perkin-Elmer Azimuth Alignment Auto-theodolites. **Short Range** — working distance, 0 - 100 feet; **Intermediate Range** — working distance, 0 - 800 feet; **Long Range** — working distance, 200 - 1,500 feet (discriminates away from rotational movement and automatically compensates for both).

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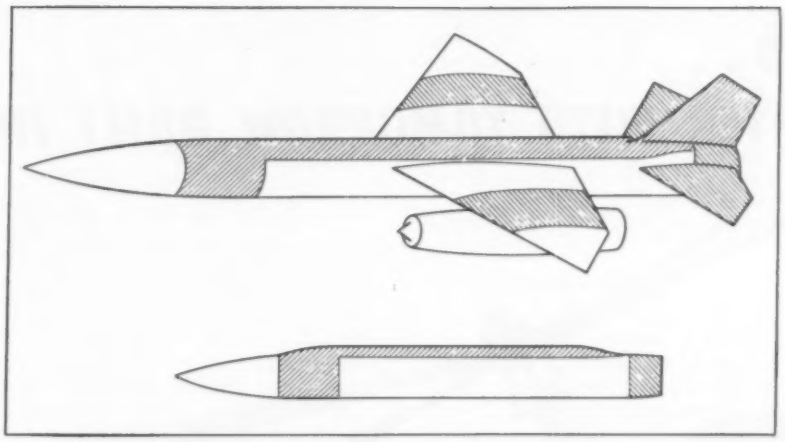

Bomarc Alloys Resist Heat

First large-scale use of heat-resistant magnesium alloys is incorporated in USAF's Bomarc missile, built by Boeing Airplane Co. Magnesium-thorium sheet is shown by cross-hatching, and airframe also contains several magnesium-thorium castings. Same alloy is used for control surface leading and trailing edges.

Wizard system is highly sophisticated with a long range, solid fuel missile and an effective multi-purpose radar with a very high degree of discrimination between warheads and decoys. They say the system has never gone beyond the planning stage simply for lack of money.

Features of the Wizard system are:

• **Phase I program** is for the development of a single stage missile with a range of 1,000 mi., and the capability of intercepting all airborne vehicles.

• **Phase II program** contemplates addition of a second stage to the missile to provide interception capabilities at altitudes of 300 to 500 mi.

USAF's prime contractors on the Wizard project have been Radio Corp. of America and Convair Division of General Dynamics Corp. Subcontractors have included: General Electric on missile warheads, Sanders Associates for multi-element, multi-lobe PANAR antenna system, D. S. Kennedy on large parabolas and Avco on electronic steering devices.

Plato System

Designed to protect field armies and critical installations overseas, the Army's Plato anti-missile missile system is into the hardware stage where prototype parts have undergone test.

A possible future application of Plato that is arousing much interest is the prospect of presenting the system to NATO allies as part of the inducement to accept IRBMs from the United States. One of the Soviets' strongest threats in Europe is the nuclear-tipped IRBM.

System is presently being considered for protection of U.S. cities from submarine-launched IRBMs.

Plato is a relatively mobile system consisting of vans for the electronic equipment, erective antennas and specially designed mobile launchers for the Nike-Zeus missile. Plato is a command guidance system whereby a computer is fed continuous position data on both the incoming target and the Nike-Zeus missile. Computer then guides the missile to the intercept point and detonates its warhead by radio signal.

Prime contractor for Plato is Sylvania Electric Products. Subcontractors are Sanders Associates, General Electric and American Machine and Foundry.

Unsolved Problems

Many problems remain to be solved before missile defense systems will be able to attain acceptably high "kill probabilities." At the present time little is known about the best method of destroying an attacking warhead. Scientists from Kirkland AFB will be conducting tests on the effects of nuclear blasts in the upper atmosphere this spring at Eniwetok.

Three techniques that seem to offer possibilities are:

• **Particle interception.** High kinetic velocity of an approaching ICBM warhead may be turned to good effect by exploding a cloud of sandlike particles in its path. Impact erosion may be serious enough to alter the re-entry characteristics of the nose cone and cause it to destroy itself.

• **Nuclear radiation.** In the upper atmosphere, where the intense nuclear radiation from an atomic explosion is not attenuated by air, fissionable material in the enemy warhead may be exploded or transmuted to a nonfissionable isotope.

• **Thermal radiation.** Because requirements for nose cone re-entry are very stringent, it may be possible to destroy

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For more information please write to **Mr. A. B. Stevenson, Engineering Personnel, North American Aviation, Inc. Los Angeles 45, California.**

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THE ARMY H-23D . . .
HELICOPTER WITH *TOMORROW BUILT IN*

Design of the basic H-23 helicopter was largely governed by a doctrine of *ruggedness*. It has produced a dependable helicopter, with a record of safety unequalled in its class.

Now, in the H-23D, a completely new 1000-hour+ drive system is introduced, seen as a major break-through in lower operating costs. A full-time 250 horsepower is available and, significantly, without "redline" restrictions warning of jeopardized service life. Thus, *ruggedness* has also afforded *growth potential*.

In the H-23D, growth potential assumes a new importance. Its existing components are *designed* to accept even greater power increases for the future's most challenging performance demands. Now, more than ever, the Army H-23 is an investment in *tomorrow*.

HILLER HELICOPTERS **PALO ALTO, CALIFORNIA**

a warhead by raising its temperature with a nuclear blast prior to its re-entry.

A consideration of using nuclear bombs in anti-missile missiles at this time is that the U. S. is not now producing enough fissionable material to meet this requirement in addition to its present commitments.

Clouds of Decoys

By the time that any part of the U. S. missile defense system is operational a new generation of problems will have arisen. Simplest technique for confusing or saturating defending radars and computers is by surrounding an attacking ICBM warhead with clouds of decoys. If the radar cannot tell the difference between them, it will see hundreds or even thousands of potential hydrogen bombs filling the air.

Both this country and Russia presently are exploring decoy techniques. The Martin Co. is studying decoys as protection for its Titan ICBM. Soviet scientists are reported reliably to be testing a technique for generating hundreds of decoys by exploding the final stage of their ICBM.

The Soviet technique consists of separating the missile's final stage rocket from the warhead somewhere before the apogee and blasting the rocket casing, fuel tanks and motor into fragments with a high explosive charge. Fragments will disperse for miles on all sides of the warhead, with many of the fragments making better targets than the warhead itself.

At the extreme altitudes where the final rocket stage would be fragmented, the very thin upper atmosphere would not slow the fragments appreciably. They would maintain about the same relative velocity as the warhead until slowed by re-entry into the heavier atmosphere about 25 mi. from the target. Decoys would be distributed over an area of several thousand square miles extending both in front and behind the warhead.

There are three techniques by which such decoys could be countered:

- **Detection at re-entry.** At re-entry, the decoys will be slowed by the atmosphere because of their relatively smaller mass compared to the warhead. With this technique it is necessary to wait until the warhead, approaching at speeds close to 15,000 mph., is about four seconds away from its destination before attempting to launch an anti-missile missile.
- **Detection prior to launching.** If the missile can be tracked by radar before fragmentation of the rocket, the target following the original elliptical trajectory could be presumed to be the warhead. This method, however, appears to be unreliable.
- **Detection by target analysis.** Several companies in this country are exploring techniques known as "fine structure analysis" of radar echoes. Fine structure analysis provides information on target velocity, scintillation, deceleration and other signal characteristics which can be used to discriminate between decoys and warheads. Much development work remains, however, before these techniques can be applied operationally.

Budget Problems

Question of how money should be spent for missile defense is still being debated. Administration and Air Force planners reportedly have accepted a Rand Corp. report recommending that the anti-missile systems be concentrated to defend SAC bomber and missile bases.

Civil defense officials, however, are said to be pressing for an extensive shelter program, based on the fact that the Arctic Warning Line should give 15 min. warning of a missile attack, which would be enough time for most of the civil population in the target area to reach shelter.

A third prospect, presently under intensive study, is a program for modifying existing and planned Nike-Hercules and Talos anti-aircraft missile installations to function also as anti-missile systems.

Navy has been studying possibilities of using Talos as a shipboard anti-missile missile for some time.

A Rand Corp. economist and systems analyst, Dr. Malcolm C. Hoag, speaking before a recent meeting of the American Ordnance Assn., argued for concentrating all missile defense for the protection of SAC.

Emphasizing that he was expressing a personal opinion, he said, "If we concentrate more of our strategic air-power in one well-defended force, and economize upon our air defenses by concentrating them primarily upon the limited but indispensable function of protecting that force . . . we would not appear likely to initiate total war, but would stand ready to punish terribly those who would . . ."

There is every indication that this will be the U. S. missile defense program for the foreseeable future.

Soviet Missile-Equipped Sub Fleet May Change U.S. Defense Tactics

San Diego—Threat of Soviet missile-carrying submarines does not demand that the United States counter with an equally large sub fleet, Adm. Arleigh Burke, Chief of Naval Operations, said here.

Adm. Burke pointed out that the answer to submarines is not more submarines, but anti-submarine vessels and aircraft. Killer submarines for anti-submarine warfare are effective but expensive.

He said that present anti-submarine measures are four or five times as effective as those used in World War II and would be quite adequate against the present Soviet fleet of conventional subs.

Nuclear Subs

However, the advent of nuclear powered, missile-carrying submarines in the Soviet navy will change the balance.

Huge areas of open water made available to the Soviets by the unlimited range of nuclear subs and the long distance from which they can strike with missile armament effectively cuts the ratio of Navy's anti-submarine warfare force to the area which it must defend.

According to experts on strategy, this is the greatest possible advantage to offense—in this case the Russian subs—because it increases the chance of finding an unexpected avenue of approach. It would even improve the usefulness of conventional subs by spreading the defense.

Adm. Burke said the Soviets have apparently cut their submarine building rate far below the 100 per month reported by some sources about a year ago. He said they are probably concentrating on the design and testing of a few nuclear subs preparatory to replacing their conventional boats.

Burke predicted that in 10 years the U. S. Navy will have several hundred nuclear-powered ships. He said many of these may be smaller than the current Nautilus and Sea Wolf as advances in technical knowledge make smaller powerplants possible.

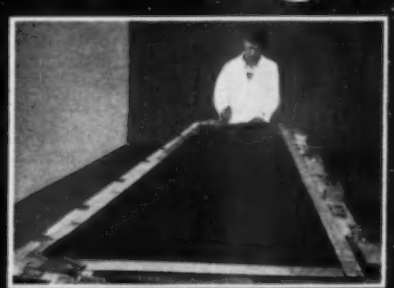
Submersible cargo ships are a distinct possibility, but Burke explained that currently it would cost 10 or 25 times as much to transport a given weight under the water as it would to carry the same weight above water.

He said the first efforts in this direction would probably be tankers, since it is not necessary to carry liquids within the pressure hull. That would minimize the engineering problem since the pressure hull bears the heaviest structural loads.

Missile Storage

Adm. Burke said that storage spaces for the Polaris fleet ballistic missile on future submarines are tailored so closely to the big rocket as to limit the size and

building the structure for modern flight



High temperature stainless steel honeycomb sandwich structure

is the exotic, new structural material now in volume production at Rohr. A stainless steel honeycomb core is formed through precision welding, then face sheets and edge members are furnace brazed to make the complete components.

Rohr Sandwich Structure is extremely strong in relation to weight, yet is able to resist temperatures up to six times as much as ordinary structural materials. Thus we now offer the designer a high temperature resistant structure with no weight penalty . . . considered impossible until recently.

Components formed of this structural material . . . vital to advancements in modern and future flight . . . naturally demand a high level of technology and specialized manufacturing equipment.

Today, these and other highly important types of structural components are in volume production at Rohr.

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shape of replacement missiles. For instance, he said, it would be difficult or impossible to carry a winged vehicle such as a ballistic glide rocket bomber.

Burke said that if a single civilian agency is given the responsibility of overseeing the development of space technology, National Advisory Committee for Aeronautics or some similar existing group should be studied before deciding to set up a new body. He noted that NACA has the advantage of an existing staff of scientists as well as working relationships with outside scientific organizations. He said the Navy has no current manned space project.

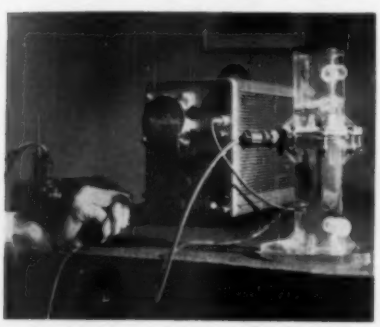
Navy's Pt. Mugu missile range will be approximately as long as Air Force's Cape Canaveral range when completed for testing of Polaris, according to Adm. Burke.

Longer Range Indicated

This seems to indicate that longer range missiles are in the mill for Navy since maximum range of Polaris is about 1,700 mi. and Canaveral range is about 5,000 mi. long.

Size and shape of the range are actually not firm yet, Burke said. Approach and departure channels for air traffic between Los Angeles and Honolulu lie right across the middle of the proposed range. Navy and Civil Aeronautics Administration are now trying to arrange a time-sharing plan to safeguard traffic without infringing too much on range schedules.

When questioned about Navy's programs in the anti-missile field, Burke said that he believes Talos to be the best existing weapon against ballistic missiles and that Navy programs for new ones are still in the research phase.



Unit Spots Defects In Missile Oxidizers

Cavitation detection in missile oxidizer systems is now possible with a detector developed by the AiResearch Manufacturing Division of the Garrett Corp. Cavitation or formation of bubbles occurs when pressure at any point in a fluid flow system approaches the vapor pressure of that fluid. Occurrence of this in missile oxidizer systems can result in explosions when the oxidizer-fuel ratio is upset by the bubbles in the system.

The detector, based on a phenomenon in the cryogenic and hydrocarbon field, determines any tendency of oxidizer and fuel systems of missiles to cavitate while undergoing development, in the test stand prior to flight, or in flight.

Another missile application is the detection of cavitation when booster rocket oxidizer or fuel sources approach depletion and pressurizing gas enters the oxidizer or fuel systems. Maximum fuel usage with greater missile range can be assured as well as maintaining a balanced oxidizer-fuel ratio before booster rockets are released.

Detector, consisting of a sensing mechanism and controller composed of electrical circuits, can transmit signals to an oscilloscope, a firing circuit such as a rocket booster ejection circuit, or a telemetering transmitter. Circuits can be calibrated for individual fluids such as water, liquid oxygen or hydrocarbons, etc., depending upon liquid traits.

Potential industrial applications for the new detector include distillate pumps in petroleum refining operations and marine and stationary boiler feed pumps.

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DATARITE magazine Type 5-047 attaches directly to the versatile 5-114 and Type 5-036 attaches directly to the 5-119 Recording Oscillograph without modifications or adapters. Magazines hold 400 ft. of thin-base recording paper. Record and event numbers are automatically imprinted for ease of data reduction. For complete DATARITE details contact your nearby CEC field office, or write for Bulletin CEC 1598-X9.

Descriptive literature on CEC's Recording Oscillographs: Type 5-114 (18 and 26-trace models, 7-inch record width) Bulletin CEC 1500-X17. Type 5-119 (36 and 50-trace models, 12-inch record width) Bulletin CEC 1536-X21.

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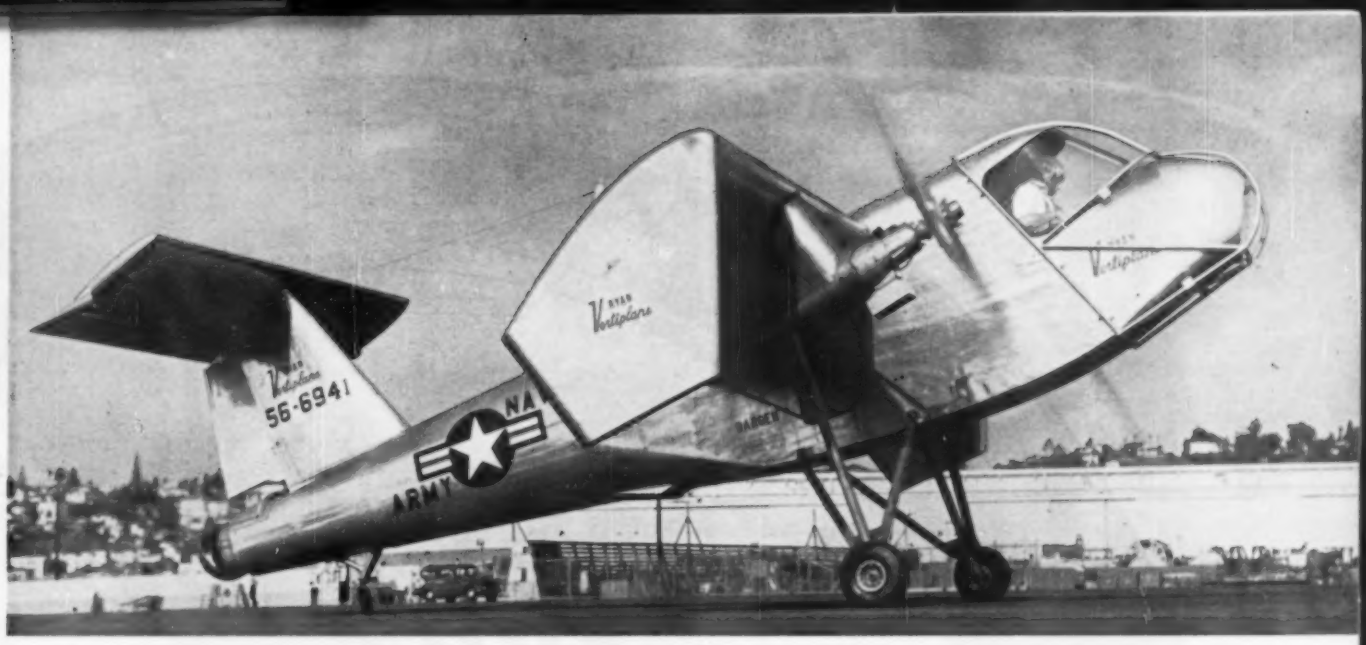
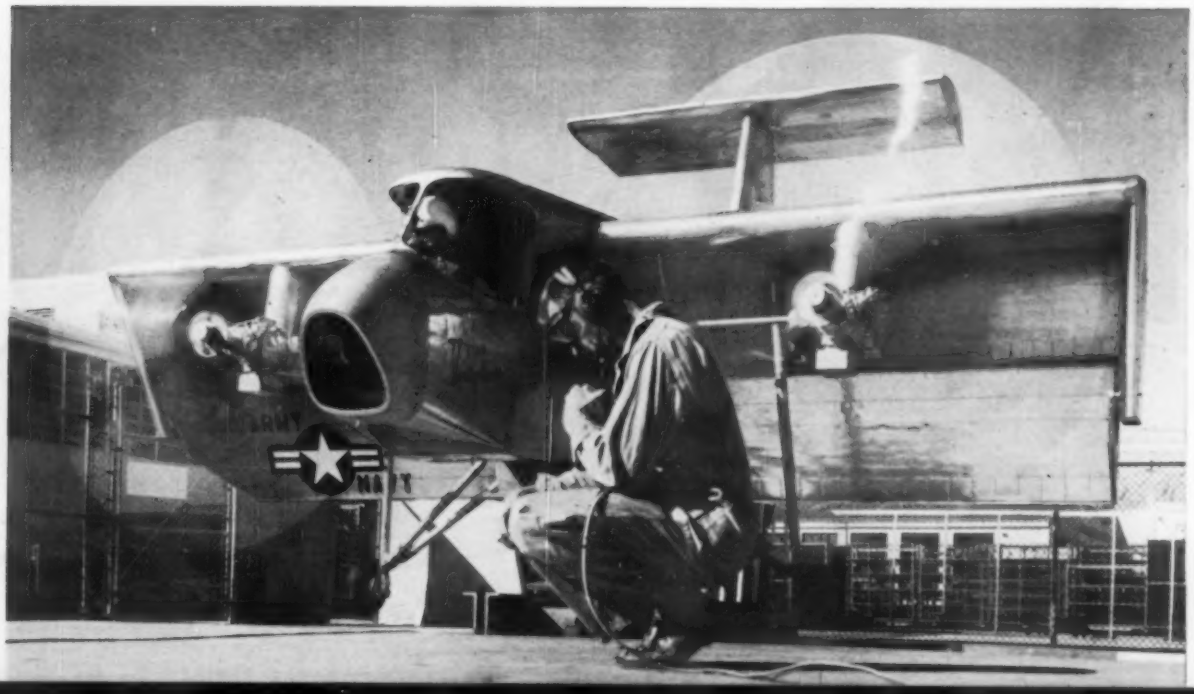


Ryan Vertiplane Taxis, Undergoes Engine Tests

Ryan Aeronautical Co. Vertiplane, Army VTOL research aircraft, undergoes taxi test (above) at Lindbergh Field, San Diego, Calif. In initial taxi tests, vehicle attained speeds between 30 and 40 mph. At right, single Lycoming T53 gas turbine engine in fuselage is run up for engine testing. Aircraft will undergo 40 hr. of engine tests before flight tests are conducted. Level lift vehicle was built under direction of the Office of Naval Research. In photo below, Vertiplane hovers during engine runup. End plates on wingtips confine slipstream to flap span and double retractable wing flaps deflect propeller slipstream. Aircraft seats two.



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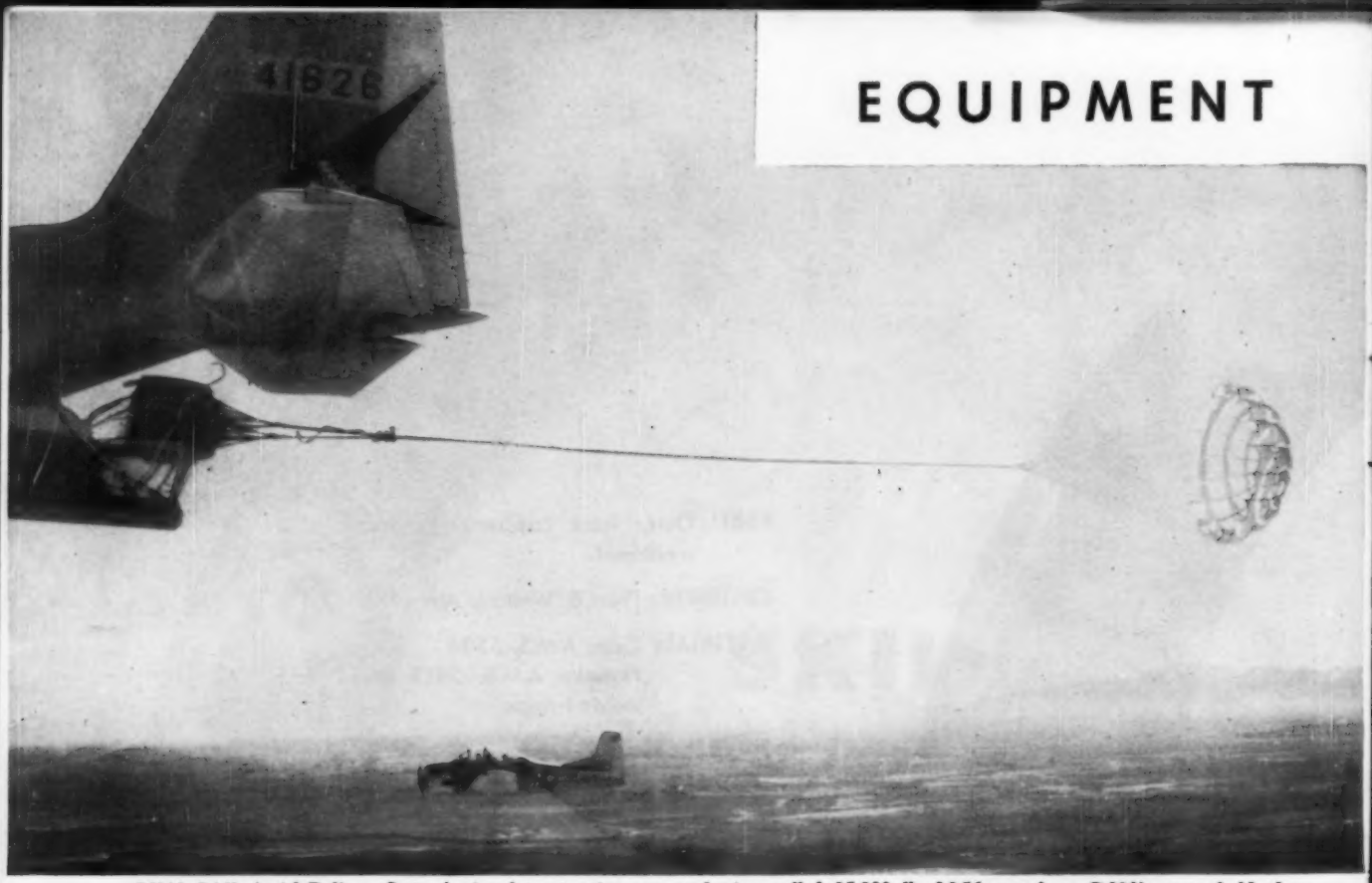


DUAL RAIL Aerial Delivery System's ring-slot extraction canopy, having pulled 15,800 lb. M-56 gun from C-130's cargo hold, drags out recovery parachutes. Rearward position of heavy load forces pilot to move elevators to nose-down position. Note T-28A observer plane.

Army Tests Automatic Vehicle Air Drop

By George L. Christian

Detroit—Automatic pushbutton-operated system of parachuting Army vehicles weighing up to 10 tons quickly and safely from cargo planes to battlefield areas will soon go into operational suitability testing. All engineering testing, conducted in three phases, has been successfully completed.

Called Dual Rail Aerial Delivery System, concept was developed to give the Army the greatest possible air-dropped logistics capability, high ground mobility and maximum firepower so essential to conducting effective brush fire war tactics.

Major advance of the new system over preceding methods of air drop is its automatic operation. Entire drop sequence of one or more vehicles is initiated by the pilot pushing a button in the cockpit; no additional assistance or manpower is required. The sometimes hazardous jobs in the plane's cargo hold, which had to be performed to release loads using old drop systems, have been eliminated.

System was developed by Brooks & Perkins, Inc., here. Company specializes in magnesium fabricating techniques and is currently turning out, among many products, 21-in. diameter magnesium satellites destined for Project Vanguard.

Heart of the system is three sizes of rugged, magnesium platforms which carry the parachuted vehicles to Earth. Design life of the platforms is a minimum of 10 drops (repeated use of platforms would occur only under peacetime practice conditions). Actual tests show that platforms can exceed the 10-drop minimum, according to Brooks & Perkins officials.

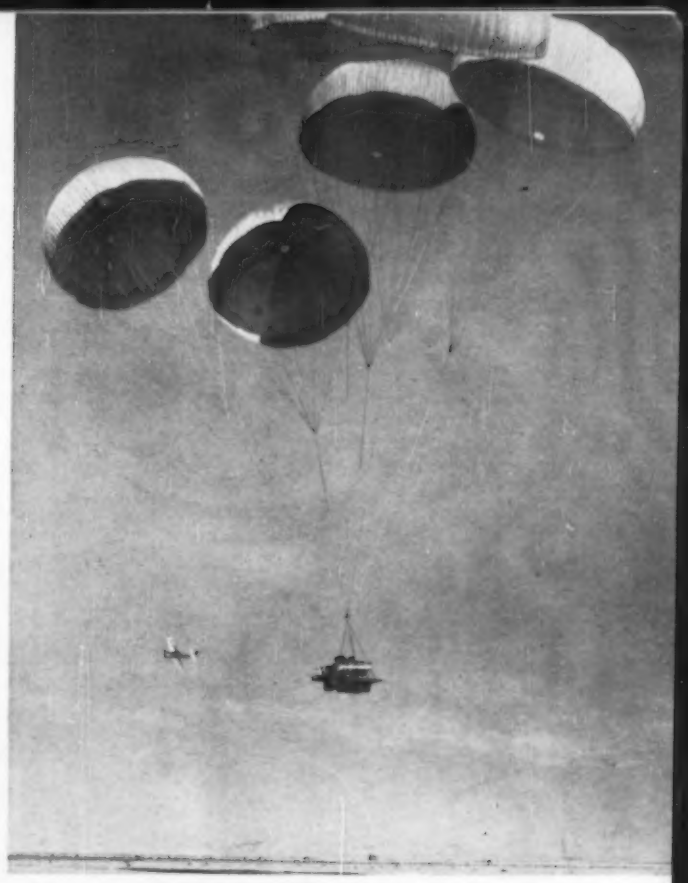
To date, some 75-100 drops have been made to test the system and demonstrate its effectiveness. Brooks & Perkins technicians say the tests pointed up cooperation between the three services: Air Force C-130s dropped Army vehicles at Navy's 6511th Parachute Test Facility, El Centro, Calif.

While the system was specially tailored to Lockheed's C-130 Hercules, Brooks & Perkins engineers have conducted a compatibility check of the system with Douglas' C-133A and found it satisfactory.

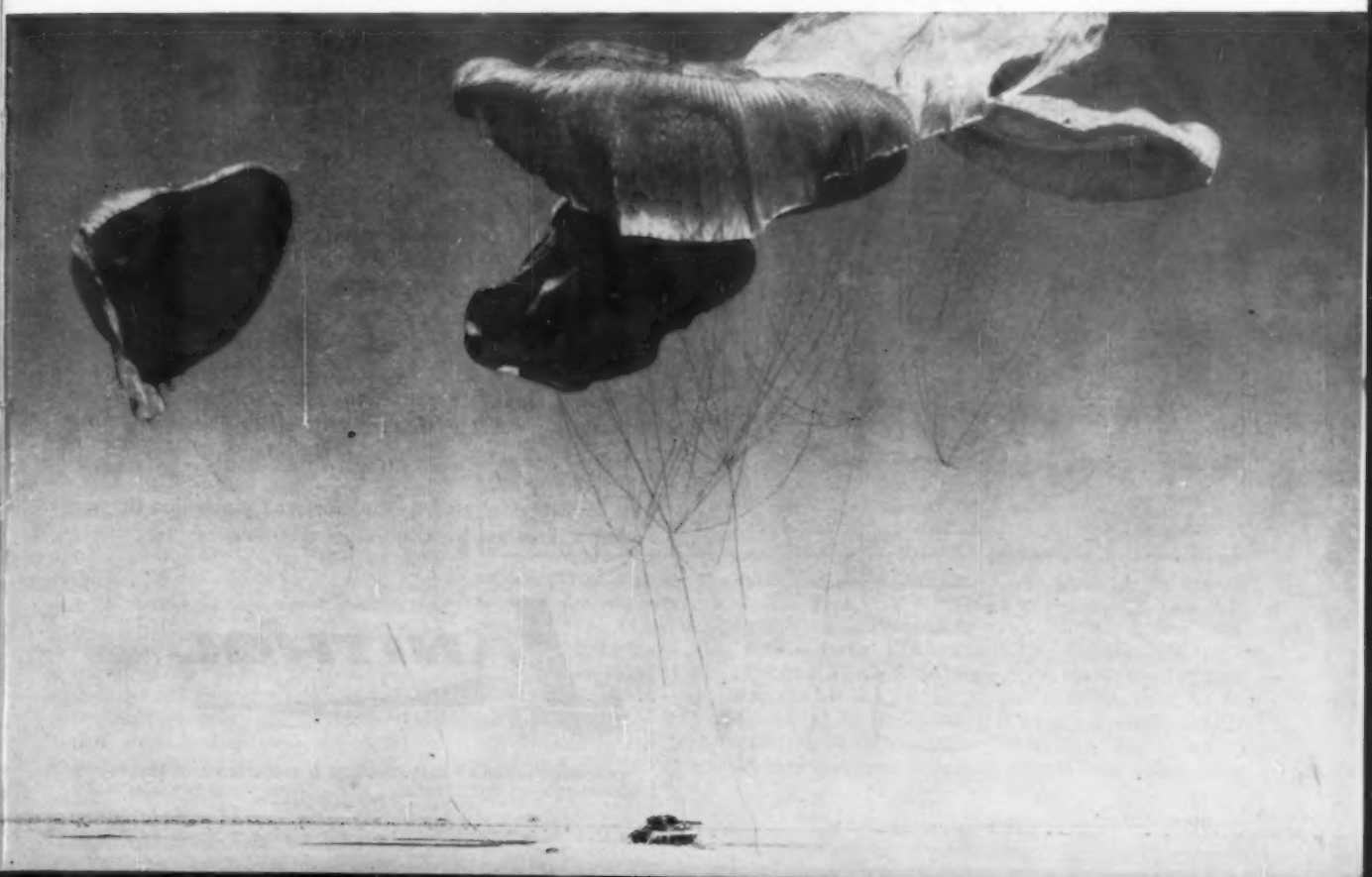
Aerial delivery system is designed to give maximum assurance that the many types of vehicles scheduled to be parachuted by this means will survive the drop intact and be capable of operation the instant they are released from their platforms. Currently 17 tanks, trucks and mobile artillery and road building equipment vehicles are scheduled for use with the system. All but two have actually been dropped.

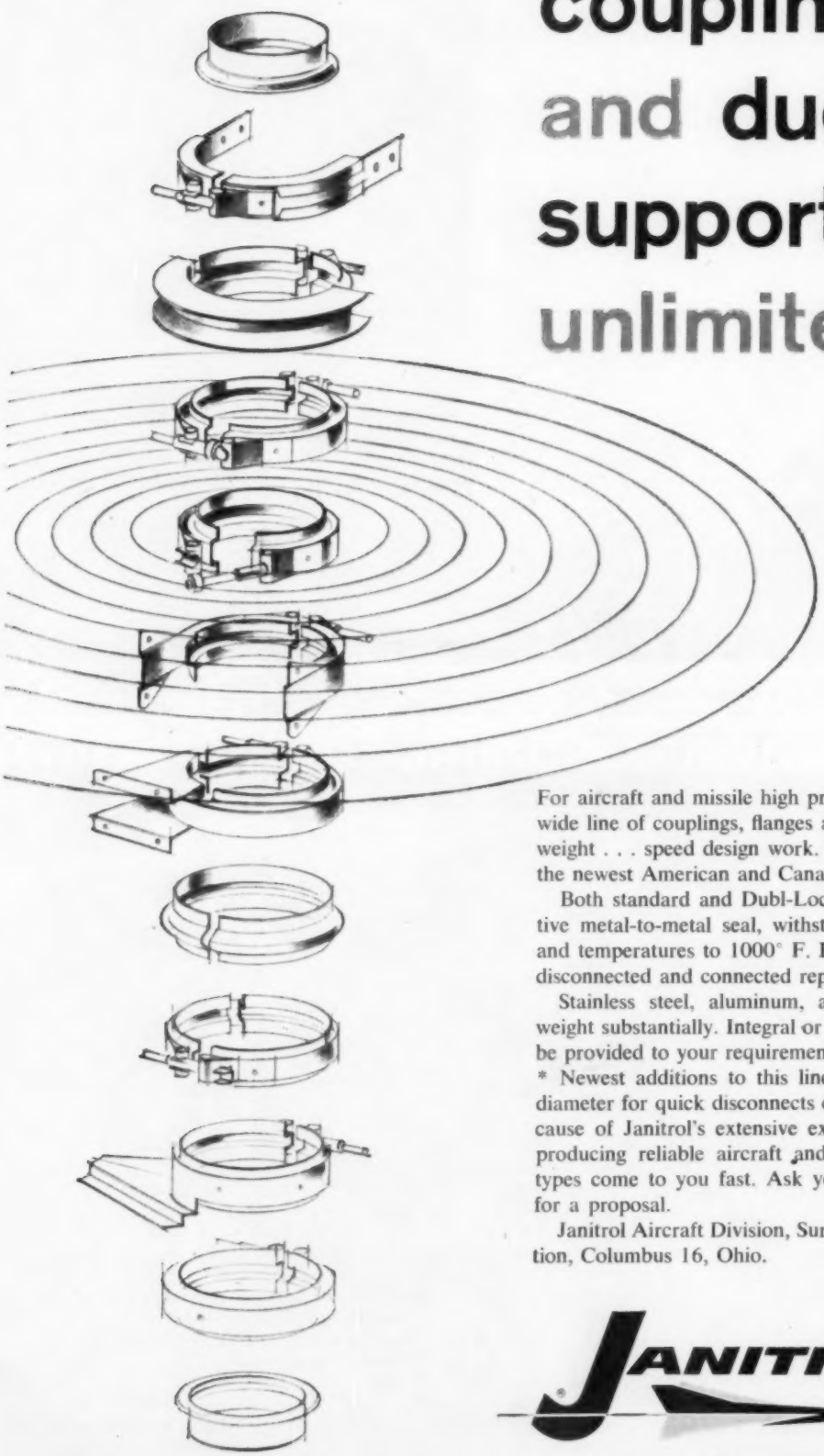
To assure maximum vehicle utility after drop the system design includes:

- **Rugged but light** magnesium platforms which carry the vehicles during the drop and protect them on landing. Company says that magnesium's resistance to bending allows it to give maximum protection and also resists damage to allow the platform to be reused many times instead of being junked after a single drop.
- **Dual restraint system**—two strong steel pins—which positively locks platform and its cargo to twin rails on floor of cargo plane to preclude possibility of the cargo shifting during flight through turbulent air. System also supplies positive, automatic release when extraction chute starts pulling cargo out of the plane. An emergency manual release is provided in case automatic system is battle-damaged.
- **Drop is accomplished** by pilot pushing button.
- **Rubber, air-inflatable** decelerator bags, several of which are used under



ARMY self-propelled gun starts to swing on parachute risers. Line from front of platform will extract second vehicle (top left). Gun floats to Earth under six 100 ft. dia. canopies which help to stop oscillation. Note deceleration bags under platform (upper right). Automatic device cuts canopies loose on landing (below).





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JANITROL

pneumatic controls • duct couplings & supports • heat exchangers

each platform, absorb landing impact then deflate quickly to prevent vehicle from upsetting.

• **Positive, quick-acting** release to cut loose multiple parachute system the instant load hits the ground and tension on suspension system shroud lines starts relaxing.

This prevents wind-propelled canopies from overturning vehicles on the ground and so rendering them useless.

System has the capability—although not uniquely—of dropping vehicles in the combat-ready (fully fueled and oiled) condition.

This permits them to go into action instantly, according to Brooks & Perkins officials.

Three Platform Sizes

Basic Brooks & Perkins system is built around these three different size platforms, all 8 ft. 8 in. wide:

• **Small size:** Length, 11 ft.; empty weight, 800 lb.; normal load, 3,500 lb.; overload 5,000 lb.

• **Medium size:** Length, 15 ft.; empty weight 1,100 lb.; normal load, 7,000 lb.; overload, 10,000 lb.

• **Large size:** Length, 24 ft.; empty weight, 2,000 lb.; normal load, 16,000 lb.; overload, 20,000 lb.

Platforms are slid into C-130 on a pair of rails whose 45 ft. length allows several combinations of sizes for multiple drops (weight of rails is about 1,000 lb.).

Among possible platform combinations which can be carried in a C-130 are: three small, two small and one medium, two medium, one medium and one large.

Para-Drop Complexities

Parachuting up to 10 tons of vehicles in single or multiple drops from altitudes of 2,000 ft., 1,500 ft. or lower with a high degree of successful delivery requires a system of a certain complexity.

Here are details of the Brooks & Perkins system:

• **Cargo is lashed** to a platform; then suspension lines and main chute system —which may include up to six chutes weighing some 1,000 lb.—are attached.

• **Platform is pushed** into airplane on rollers mounted on dual restraint rails. Load is quickly made fast to rails with twin, steel restraint pins which slide into reinforced fittings, one in each rail.

• **Extraction chute**—using ring-slot canopies 15 ft. or 22 ft. in diameter—is hung on a standard bomb shackle in the upper rear portion of the airplane's fuselage and connected to the front of the platform immediately behind it so that each load follows the other in quick succession.

• **Cargo doors are opened.** Pilot pushes a button in the cockpit to release extraction chute in much the same manner a bombardier releases his bombs. After the release button is pushed, entire drop sequence is automatic.

• **Extraction chute,** released from the bomb shackle, swings downward and rearward through 90 deg. arc, which action pitches it out of the plane.

• **Parachute, released** from the bomb shackle, swings down and rearward through 90 deg., being attached to the plane's structure by a line. Motion pitches it out of the aircraft and deploys canopy immediately.

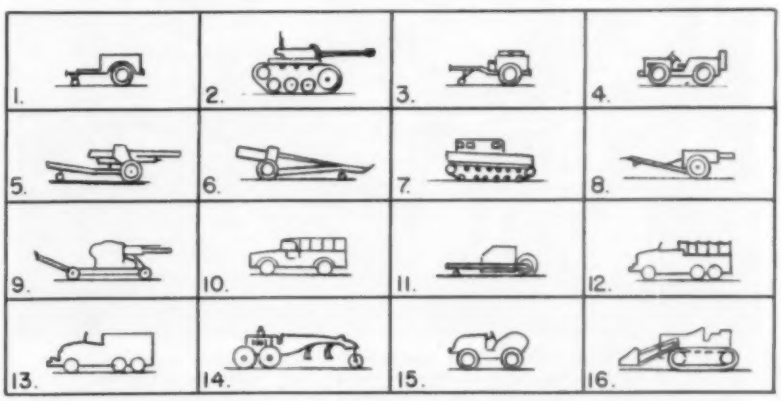
Force exerted by extraction line on platform accomplishes these three things:

• **Pulls restraint pins** through a mechanical linkage to release the platform. Job can be done manually if automatic mechanism fails.

• **Hauls platform** backward out of the airplane's hold.

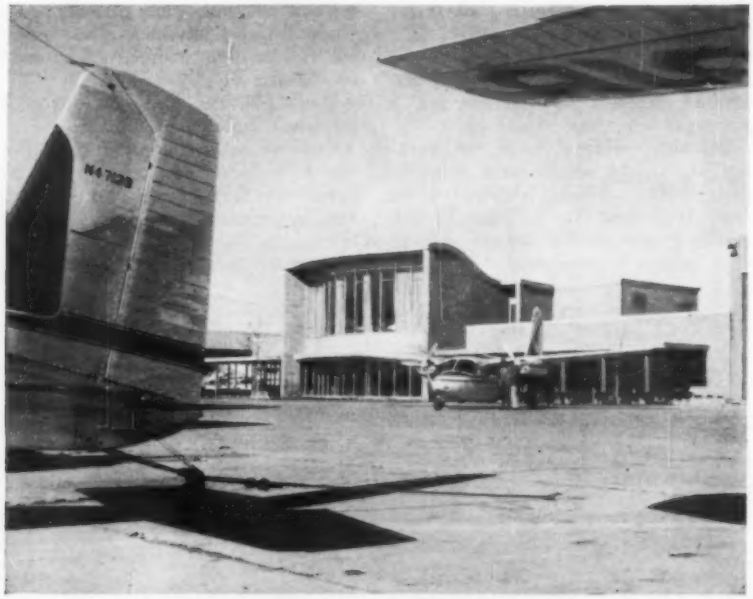
• **Deploys main canopies.** As platform leaves the plane, an arm on the platform, which rides on the side of a rail, is released and swings out. This releases fitting from the platform and extraction force is transferred through

FIRST successful drop of an M56 gun on a stressed magnesium platform. Deceleration bags have been compressed under load. Anti-toppling doors extend beyond platform.



SILHOUETTES of family of vehicles and road-building equipment which can be dropped by aerial delivery system: 1. Trailer, 1-ton, 2W water tank (3,500 lb.); 2. Gun, self-propelled, M56 (15,800 lb.); 3. Trailer, 2-ton, 2W ammo., M10 (6,250 lb.); 4. ¼-ton truck, 4X4 M38 (3,425 lb.); 5. Gun, 57 mm., M1A3 (2,850 lb.); 6. Gun, 76 mm., T66 (6,950 lb.); 7. Carrier, cargo, M29 (5,277 lb.); 8. Howitzer, 105 mm. (5,130 lb.); 9. Gun, 40 mm., M2A1 (5,850 lb.); 10. ¾-ton truck, 4X4 M37 (7,800 lb.); 11. Erie scraper A68 (°); 12. 2½-ton truck, 6X6 M34 (17,540 lb.); 13. 2½-ton truck, 6X6 M35 (dual rear wheels) (18,015 lb.); 14. Road grader 212 (°); 15. Tractor, MRS 125 (14,940 lb.); 16. Tractor HD-5G w/bucket loader (16,740 lb.). All units have been dropped by aerial delivery system except two vehicles marked (°).

Flyers Agog at Spectacular New Terminal



Crews and passengers unload conveniently at front door. Main lobby, VIP office, flight ops room downstairs; Flight Deck Restaurant, coffee shop on second floor.

Luxuriously-furnished main lobby features oak paneling, terrazzo floor, colorful view of ramps and runways. Adjacent flight ops, rent cars, and restaurant.

BIZ AVIATION'S TOP SHOWPLACE WINS APPROVAL

Beauty and Comfort

The day Southwest Airmotive opened the doors, its new business and military flying terminal became the scene of unrehearsed drama and happy human emotion.

A pretty mink-swathed lady who'd flown into many an airport with her pilot-husband dashed about breathlessly inspecting the plush SAC layout. She summed up everyone's reaction when she sank at last into a deep chair in the lobby and said, simply: "Ahhhhhhhhhh."

Fine Restaurant

An oldtime executive pilot was overwhelmed by the flight ops room and related etceteras and just frankly couldn't believe it all.

"It's great," he said. "But where's the catch – what'll it cost me to use all this?"

He nearly split his leathery face wide-open grinning when told, "Nothing — nothing at all, podner."

When the manager of the second floor Flight Deck Restaurant first saw the night-time view out his great panoramic window, he sat down almost reverently and said, "Where have I been all my life? What a place to eat!"

Flight Operations

The top VP of a firm making new business planes cancelled an appointment, spent an hour taking it all in, then observed:

"We've arrived — and I don't mean just Southwest Airmotive. All of us in business aviation Have Now Arrived."

Now, we want to know what YOU will say. Come take a look — we predict you'll say plenty.

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1932 —— A QUARTER CENTURY OF LEADERSHIP —— 1958

a line from platform to bags in which main chutes are packed.

Suspension lines and chute risers are deployed, bags are stripped from the canopies and load becomes parachute-borne. Initial oscillations are damped by multi-chute system as cargo floats to Earth. Descent time varies with launching altitude but averages about 30 sec.

Diameter of main canopies is either 64 ft. or 100 ft., depending on the weight of the load being dropped.

Decelerator Bags

As the extraction fitting is released from the platform, a cartridge with a 14-sec. delay is actuated. When it fires, it trips a lever to open metal-faced, plywood anti-toppling doors on the bottom of the platform. There are four doors on the small platform, six on the other two sizes.

Doors are spring-loaded to swing outward 180 deg. so that, in the open position, they extend somewhat beyond the sides of the platform. This prevents edges of the magnesium structure from digging into the ground, helps the entire load to slide along the surface of the terrain and avoid overturning.

When doors open, they release collapsed cylindrical, rubberized nylon decelerator bags 42 in. deep and 35 in. in diameter.

Bags inflate with air through 12 in. diameter openings at the bottom of each unit passing through one-way flapper valves which keep the air from escaping on landing impact.

Compression of bags as load settles to the ground blows out special bungs on the top of the bags, releasing entrapped air through rubber diaphragms which act as variable orifices; they expand from a normal opening 4 in. in diameter to a diameter of 7 in. under pressure. Purpose of the variable orifices is to get maximum work out of the bags by maintaining constant pressure within them during deflation. Bags are made by Goodyear Tire and Rubber Co.

Automatic Parachute Release

Another automatic system, which includes cartridge actuation, cuts the main canopies almost immediately after the load touches down.

Release occurs when relaxation on load suspension system reaches 25% of maximum.

Parachute release sequence is initiated when the main chutes are dragged off the cargo platform as load is extracted from the plane. Force which pulls chutes out also fires a 20-sec. delay cartridge. Delay prevents inadvertent separation of canopies from cargo during the jar of parachute opening.

When the cartridge fires 20 sec. after load leaves the plane, it allows the ground disconnect fitting, located between chute risers and platform suspension slings, to release the canopies through sling action when tension on the fittings relaxes 75%. This prevents the chutes from dragging and overturning the cargo.

Advantages of Magnesium

Brooks & Perkins engineers told AVIATION WEEK that they manufacture the platforms out of magnesium for two reasons: its lightness and its low modulus of elasticity. This latter attribute gives platform the ability to absorb deflection loads with less damage to the structure than if it were made of such other metals as aluminum or steel. They cited these modulus of elasticity figures: Magnesium—6.5 million; aluminum—12 million; steel—29 million.

Admittedly, drops made during actual combat conditions would result in the relatively expensive platforms being used only once.

However, since the platforms are rugged enough to be used many times over during the numerous peacetime practice drops they will be subjected to, Brooks & Perkins officials feel that the platforms' overall cost will be comparable to, or less than, other impact-protection devices available.

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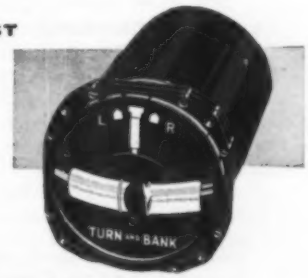
STANDARDIZED FOR LOWEST COST

Always specify standard R. C. Allen Turn and Bank Indicators, built under most rigid quality control according to government specifications MIL-I-7805, MIL-I-7805A, MIL-I-7627A, and MIL-I-5488, and to CAA TSO-C3a, AS395.



R.C.Allen Aircraft Instrument Company
Division of R. C. Allen Business Machines, Inc.
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This 4 to 6-place Commander is the first and only pressurized twin-engine transport built expressly for business. High speed, high-altitude comfort, all-weather air conditioning, optional lavatory compartment and handsome new interiors are but a few of the performance and comfort features of this new supercharged Commander.

SUPER 680

A favorite with men in a hurry, this supercharged business transport delivers the executive team to its destination ahead of all competition. The 7-place 680 Super is the fastest airplane in its class with a top speed of 260 mph and a cruise speed of 230 mph.

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FOR * PERFORMANCE
* COMFORT
* SAFETY

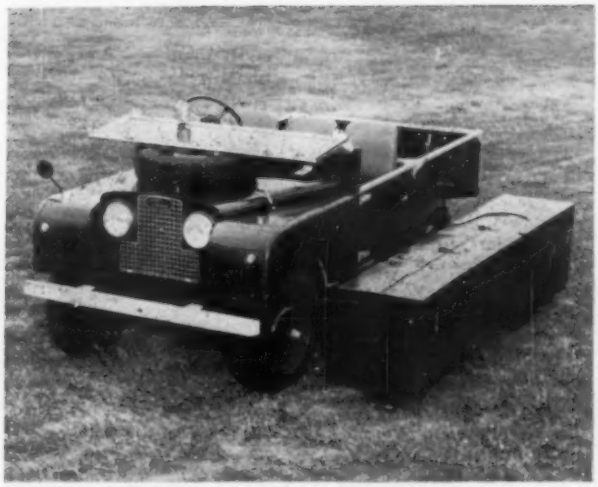
560-E

A wider wing span plus powerful new Lycoming high-compression engines give the 560-E great range and load carrying capabilities. This 7-place model of the Commander is the most comfortable and luxurious airplane in its price class.

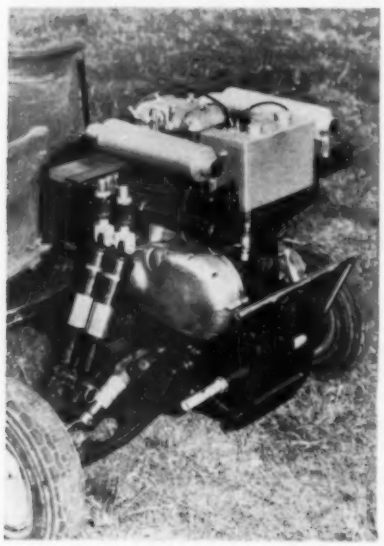
Illustrated brochures and new "Tailored to Business" Lease-Finance Plan are available on request.

AERO *Commander*

AERO DESIGN & ENGINEERING CO • BOX 118 • BETHANY, OKLAHOMA



STANDARD jeep is compared with folding model (left). Legs support weight until wheel linkage, shock struts are connected (right).



REAR wheels are driven by rear-mounted 650 c.c. twin cylinder motorcycle engine (left). Flat bottom traverses rough terrain (right).

Folding Jeep Built of Aircraft Materials

London—Four-passenger, 700 lb. airborne folding jeep with a top speed of 60 mph. which can be parachuted to almost any terrain is being built by Hunting Percival Aircraft, Ltd., at Luton Airport, England.

Use of aircraft materials and building techniques allowed the company to squeeze the vehicle, when folded, into a package 9 ft. long that occupies 33 cu. ft.

It occupies less than 1/5th the volume and scales less than one fourth the weight of a standard ¼-ton truck or jeep, according to the manufacturer.

Jeep is powered by a 650 c.c. BSA twin cylinder rear-mounted 35-40 hp. motorcycle engine.

Suspension is independent all around and steering is by rack-and-pinion.

Jeep Details

Manufacturer lists these features it has designed into the airborne jeep:

- **Forms its own** container when folded and can be stacked in an aircraft without racking.
- **Handling by four-man** crew is simple when folded. They can unfold it and make it roadable in one minute.
- **Flat bottom** of vehicle, when in operating condition, makes it easy to drag or skid over rough terrain by the crew. Optimum ground clearance is 6½ in.

Engine drives rear wheels through compounded chains. Differential is eliminated for reasons of weight and simplicity. A clutch is incorporated in the gear shift lever.

Chassis structure consists of a deep, narrow central beam made of light alloy. Hinged to it on either side are dual sheet aluminum panniers which include two folded seats each.

Panniers, which form the container when folded, swing outward and downward to make the vehicle roadable. They lock to the chassis bottom.

Front and rear wheels are mounted to the chassis with shock absorbing struts to cushion the ride. Wheel suspension, steering and drive linkages can be partially disconnected and stowed or assembled with minimum effort.

NEW AVIATION PRODUCTS

Photo-Recording Paper

Photo-recording paper that supplies data on in-flight missiles up to 10 sec. after contact, has been developed for use in conjunction with new special-type moving-mirror galvanometer oscillographs at trace velocities ranging from 0 to 3,000 cps.

Kodak Linagraph Direct Print Paper can be used in tests of high-speed, manned jet aircraft, monitored by technicians on the ground, to assure that the aircraft has been subjected to the proper test conditions. Any errors made can be discovered promptly and corrected. Previously, when in-flight errors were made, the mistakes very often were not discovered until landing.

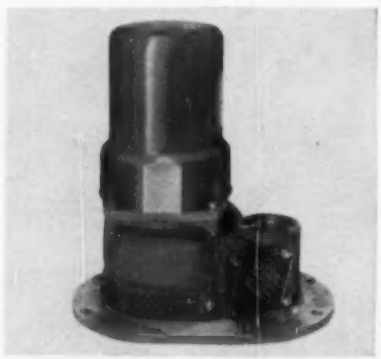
The new material, while holding impressions sharply and adequately, is made to give a high degree of permanence by bathing in a 10 to 30 sec. bath with a 30% solution of acid fixer supplied by the manufacturer, followed by a five-minute water wash.

Eastman Kodak Co., Reproduction Sales Division, Rochester 4, N. Y.

Fuel Booster Pump

Submerged electric-motor-driven centrifugal fuel booster pump is designed to pump either JP-4 or aviation gasoline over distances such as from outboard wing tanks on large aircraft.

Model RR 11700 operates in ambient temperatures from −65 to +160F, fuel temperatures from −65 to +135F, from sea level to 60,000 ft. Unit has a minimum continuous duty life running wet of 1,200 hr., running dry of 100 hr. Explosion-proof motor is



1.1 hp. at 7,300 rpm., 200 v. a.c., 400 cycle, 3 phase, 4 wire and operates with case temperatures up to 400F.

Pump is rated at 20,000 pph. at 16 psi. gage, 16,000 pph. at 21 psi. gage, and 10,000 pph. at 26 psi. gage pumping fuel per MIL-F-5624 (JP-4).

Lear-Romec Division, Lear, Inc., Elyria, Ohio.

Chamber to Test Nuclear Aircraft Engines

Steel chamber will test nuclear-powered aircraft engines at the CANEL Project (Connecticut Aircraft Nuclear Engine Laboratory) in Middletown, Conn. The $500,000 pressure vessel measures 40 ft. long and 12½ ft. in dia., weighs 160 tons and is designed to contain internal pressures of 250 psi. Chamber, constructed by Lukens Steel Co., will be installed at CANEL site early this year.

Laminated Plastic Tubing

Laminated plastic tubing is available for use as ducting for liquids, gases or air under pressure; as plumbing for corrosive acids and alkalis; and nonmagnetic insulating and dielectric flex conduit for electrical and electronic applications, the maker states.

Specifications for 10-1010 tubing are: Material per MIL-C-7719, weight, 071 lb./in./ft. of length; sizes ⅛ to 4 in. dia. in ⅛ in. increments; lengths to 10 ft.; burst pressure 70 psi.; flame resistance per MIL-D-6441; color, olive drab.

Airconductors, 376 Olive St., Gardena, Calif.

Axial Piston Water Pump

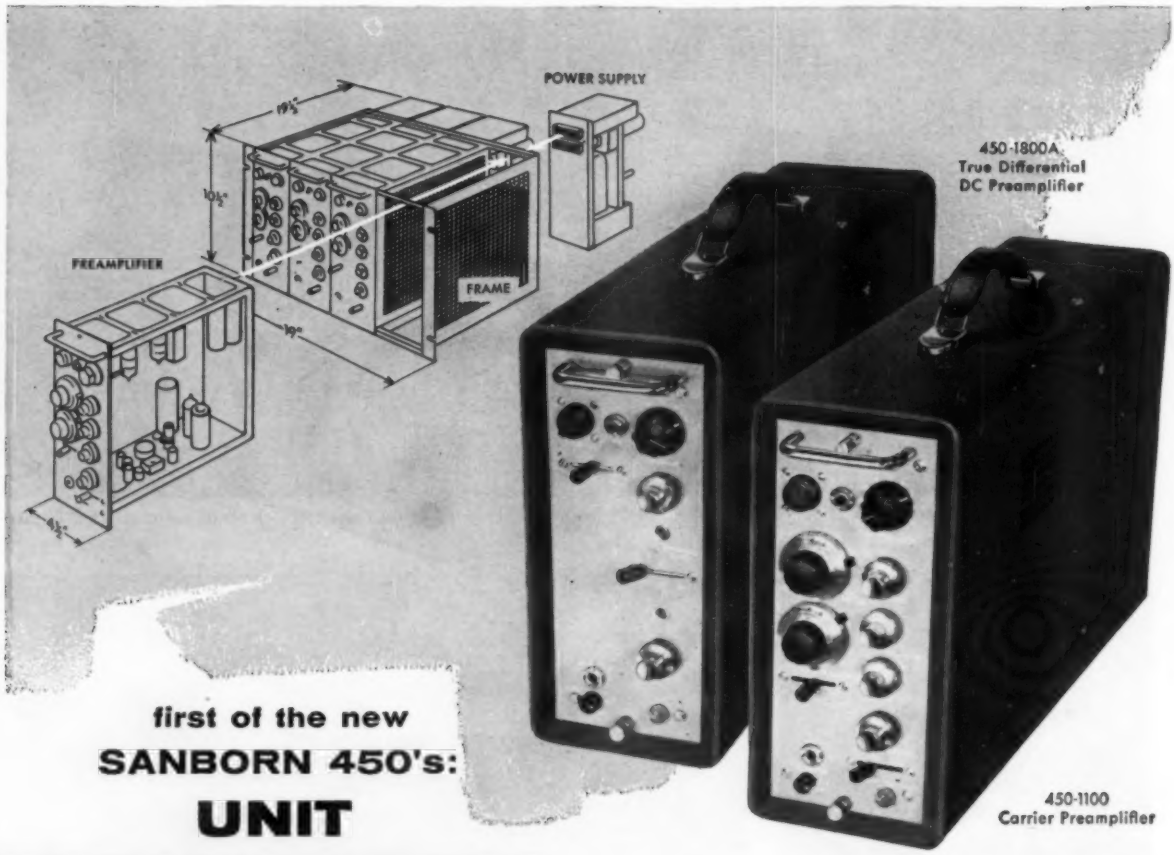
Designed for applications requiring low flow and high pressure, such as actuating landing gear on missiles or aircraft, Model P917-3 pumps distilled water and other corrosive fluids as well as hydraulic and lubricating oils, the manufacturer states. Reservoir containing water soluble oil circulated by an internal charge pump pressure lubricates the components. Five axial pistons located in a stationary block are actuated by a rotating wobbler. Rotary vane internal lube pump is not required when pumping non-corrosive fluids.

Motor is 400-cycle, 200-v., 3 phase, 8-pole 2½ hp. at 5400 rpm. Capacity is 1 gpm. at 3000 psi. pumping distilled water. Duty cycle is 1 min. "on" and 5 min. "off." Ambient operating temperatures are 32 deg. to 250 deg. F with fluid temperatures from 60 deg. to 196 deg. F.

Lear-Romec Division, Lear, Inc., Elyria, Ohio.

Manual Shut-Off Valve

Manual shut-off valve Model 949T for high pressure gas systems and missile and rocket applications is available. Manufacturer claims it exceeds valve requirements of MIL-C-2680. Shut-off is provided by means of a resilient O-ring which is completely withdrawn from the fluid stream when the valve



first of the new

SANBORN 450's:

UNIT PREAMPLIFIERS

with Integral Power Supplies

These new Sanborn Unit Preamplifiers—designed to drive optical recording systems, tape recorders, wide band oscilloscopes, panel meters and other devices—offer you an outstanding combination of performance characteristics, operating versatility and ease, flexibility through interchangeable design, and compactness in either single unit or four-unit rack module packaging. The 1100 Carrier and 1800A True Differential DC types are versatile enough to cover the vast majority of input signal requirements, with practically any type of transducer. (For use with high speed optical galvanometers at frequencies above 500 cps, requiring larger current swings, a transistor output amplifier is built into the 450-1800A and available as optional equipment on other 450's.) Later "450" Unit Preamplifiers will include Servo (demodulator) Monitor, DC Coupling, Logarithmic, Low Level and Dual-Channel DC types. As shown, any "450" can be installed or quickly interchanged in any bay of the four-Preamp module, or in a portable case.

Supplementing the basic specifications, the 450-1100 is a carrier amplifier-demodulator with zero suppression, which provides excitation for and accepts the outputs of various resistance bridge, variable reluctance, differential transformer and other types of transducers. The 450-1800A is a low-noise, low drift, wide band-width, high gain true differential DC amplifier, with front panel controls for smooth gain, position, and internal 2 mv calibration signal. For further data or application information on these new self-contained Unit Preamplifiers, contact your Sanborn Industrial Engineering Representative or write the Industrial Division of Sanborn Company.

SANBORN COMPANY

175 Wyman St., Waltham 54, Mass.

SPECIFICATION SUMMARY

MODEL 450-1800A TRUE DIFFERENTIAL DC PREAMPLIFIER

Input — Impedance: 200K differentially between terminals (balanced) or 100K each input lead to gnd. (single-ended)
Common mode rejection: at DC, 100 db; to 60 cps, 94 db; 400 cps, 80 db.
Equiv. input drift: ±2 uv for 24 hours
Equiv. input noise: 5 uv peak to peak (0–10 cps), 20 uv (0–1000 cps), 50 uv (0–30 kc)

Output — Low Power Circuit:
Output appears between two cathodes as true push pull signal.
Common mode level of cathodes ±2 volts with respect to ground.
Output capability: ±3 volts into 5000 ohms
±10 volts open circuit
Zero position control *not* active for this output
Freq. response: 3 db down at 30 kc
Linearity: 0.1%
High Power Circuit:
Output appears between two emitters as true push pull signal.
Common mode level of emitters ±2.5 volts with respect to ground.
Preferred load: 50 ohms
Output: ±2.5 volts, ±50 ma
Freq. response: 3 db down at 15 kc
Linearity: 0.5%
Zero position control is operative for high power output ckt.

Gain — Fixed steps 1000, 500, 200, 100, 50, 20
Gain Accuracy 0.5% for D.C.
Smooth gain control covers range between fixed steps

Power Req. — 115 volts, 60 cps, approx. 50 watts

MODEL 450-1100 CARRIER PREAMPLIFIER

Carrier Freq. — 2400 cps (std.), 600, 1200, 4800 cps optional

Carrier Exc. — approx. 4.5–5 volts, depending on transducer imped.

Transducer Imped. — 100 ohms min. - 1000 ohms max.

Input Imped. — approx. 2500 ohms, incl. zero sup. ckt.

Sensitivity — 100 uv rms from transducer (output imped. 1000 ohms or less) gives 1 volt at output under max. output loading

Output — preferred circuit: between one active cathode and one reference cathode
alternate circuit: between active cathode and ground

Output Voltage Capabilities — (a) ±3 volts into 2.2K min. load
(b) ±6 volts into 5K load
(c) ±7.5 volts open ckt.

Output Linearity — better than 0.2% for (a) above

Output Impedance — approx. 1000 ohms, preferred ckt., 500 ohms alternate output ckt.

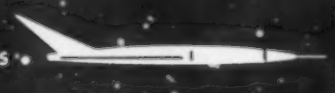
Freq. Response — 3db at 20% of carrier freq.

Zero Suppression — can suppress 0 to 100% of transducer load (either sense via switch)

Power Req. — 115 volts, 50–400 cps, approx. 30 watts

EGULUS • THOR • CORPORAL • POLARIS • SERGEANT • HAWK • SUBPUP • TERRIER • ATLAS • NIKE • AJAX • SNARK • LACROSSE • MATADOR

NORTH AMERICAN • NORTHROP • LOCKHEED • McDONNELL • REPUBLIC • BELL • MARTIN • DOUGLAS •



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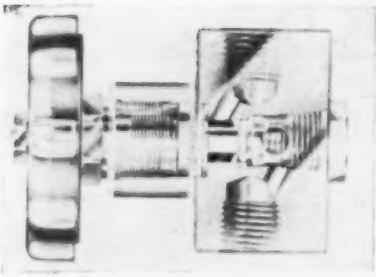


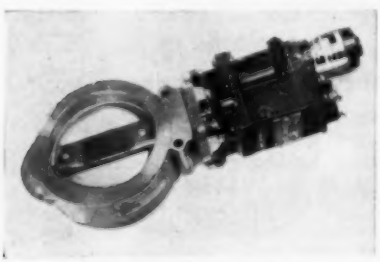
begins to open. Throttling is accomplished by means of a conical metal plug which varies the orifice area. Rated at 0-5,000 psi., valves handle either hydraulic, pneumatic, or other gas service.

James, Pond & Clark, Inc., 2181 East Foothill Blvd., Pasadena, Calif.

Butterfly Fuel Valve

Two corrosion-resistant, motor operated butterfly valves are claimed to save 20% of weight in comparison with similar gate valves.

Features of these valves are: corrosion-resistance, leaktight construction, thermal relief in either or both directions and a 27 volt d.c. lightweight actu-

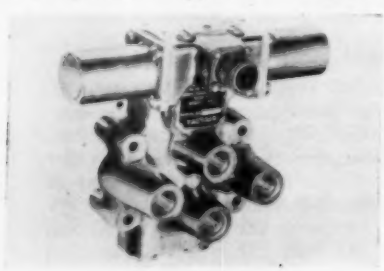


ator to operate under a wide range of conditions. The valves have both visual and electrical valve position indicators, are designed for a temperature range from—65F to plus 160F in fuels, with a pressure of 60 psi. (proof: 120 psi.). They are made in 3″ and 4″ sizes.

Parker Aircraft Co., Fuel Division, Los Angeles, Calif.

Solenoid Selector Valve

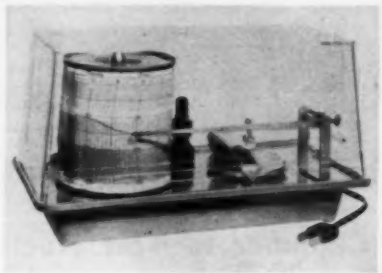
Solenoid-operated, four-way, pneumatic selector valve that operates over a wide pressure range is available. Model 9801, developed for use in a rocket release system, is applicable where low



leakage, small size, ½ amp. current drain and quick response is required, the maker states.

Model 9801 has: pressure range of 500 to 3,000 psi. from sea level to 70,000 ft., flow capacity of .2 Qu, leakage of 3 cc./hr. max., and operation time of .05 sec. max. Aluminum alloy housing measures 2¼ in. x 4¼ in. x 5⅝ in. and weighs 1.9 lb. Normal pressure is 1,250 psi., proof pressure is 4,500 psi. Operating temperature range is — 65F to + 160F.

Tactair Valve Div., Air Products Co., 300 Church Rd., Bridgeport, Pa.



Recording Barometer

Recording barometer is designed for private pilots, amateur meteorologists, etc. Instrument has bronze lacquered movement with calibrated accuracy of .05 in. Hg. at 31.0 in. and 28 in. Hg. Motor, 60 cycle, 110 v., drives 4-in.-dia. drum with a seven-day strip chart. Operates from sea level to 5,500 ft. Cost is $49.50.

Aircraft Components, Inc., Benton Harbor, Mich.

Tubing Joint

Tubing joint for connecting tubing and ducting of dissimilar metals subject to extreme temperatures has been developed for aircraft and missiles. Joint is all-metal, with a compression-type gasket said to have the flexibility and sealing characteristics of organic seals. It is recommended for high-pressure pneumatic, liquid oxygen, hydraulic, exhaust and fuel systems.

Temperature range is — 300F to + 1600F. Sizes from 1 to 12 in.

Marmon Division, Aeroquip Corp., 11214 Exposition Blvd., Los Angeles.

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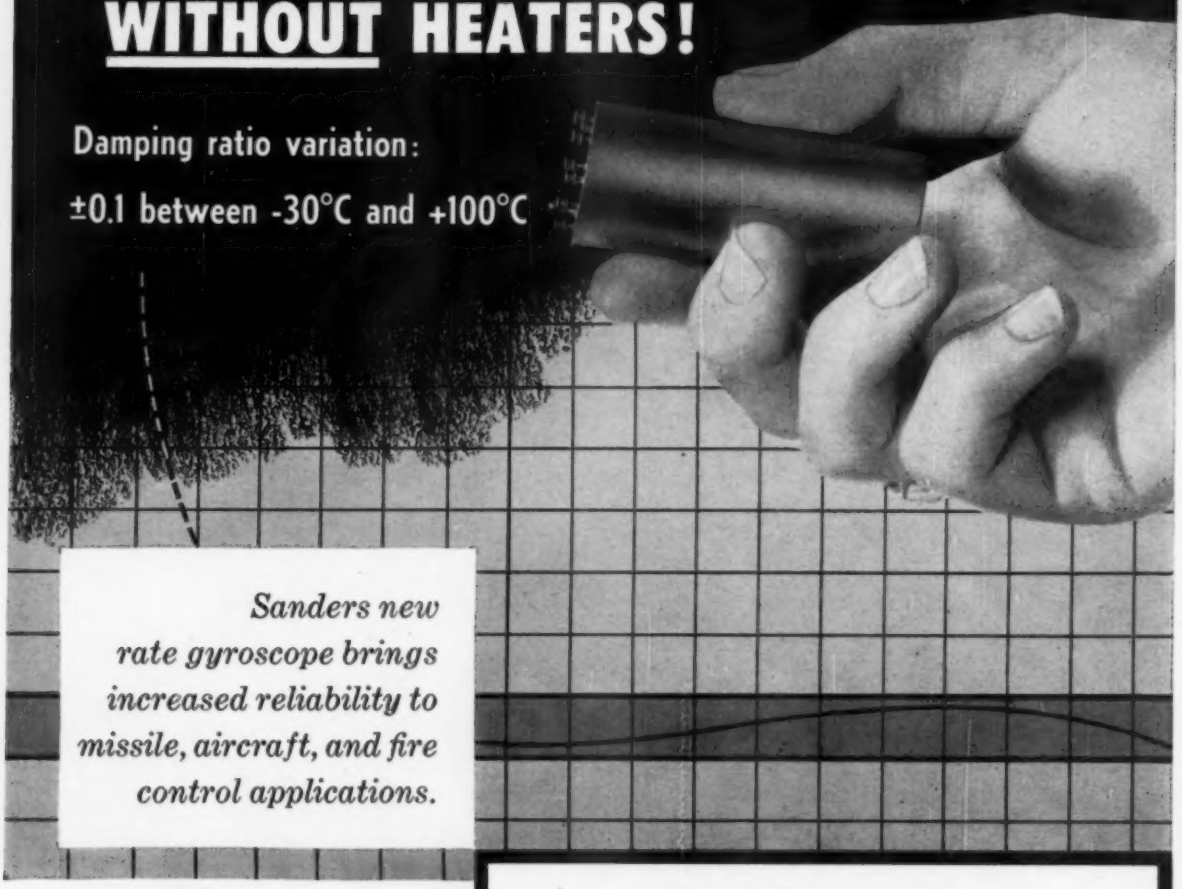
±0.1 between -30°C and +100°C



Sanders new rate gyroscope brings increased reliability to missile, aircraft, and fire control applications.

A new, simplified fluid temperature compensating mechanism, using *no linkages*, gives this precision subminiature instrument a constant damping characteristic despite changes in damping fluid viscosity. In addition, this new Sanders gyro, Type RGB, retains many of the outstanding design features of Sanders Type RGA gyro . . . in mass production since 1952.

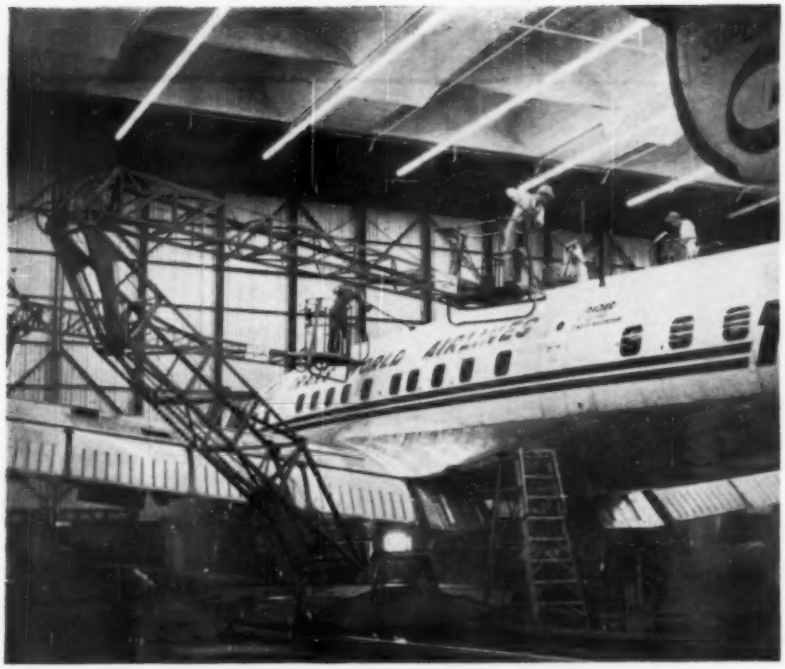
Sanders' diversified experience in electromechanics and electronics can help solve your instrumentation problems. Extensive engineering and manufacturing facilities are available for designing and producing many types of gyros and accelerometers, as well as complete control and guidance systems.

SPECIFICATIONS

Input Rates (full scale)	±40 to ±1000 deg/sec
Nominal Damping Ratio	0.5 ±0.1 from −30°C to +100°C
Resolution	0.01% full scale
Linearity	±0.1% to half scale
Sensitivity	5.6 mv/deg/sec to 140 mv/deg/sec
Zero Set (External Adjustment)	0.05% full scale
Hysteresis	±0.15% full scale
Pickoff Output	5.6 vrms with standard excitation
Size	15/16" D x 2 1/2" L
Weight	4 1/2 oz
Vibration	Up to 70g from zero to 2000 cps
Shock	Up to 100g
Acceleration	Up to 100g
Operating Temp. Range	−55°C to +100°C

SANDERS ASSOCIATES, INC.

NASHUA, NEW HAMPSHIRE • *Dayton, Ohio* • *Inglewood, California* • *Washington, D. C.*



Towers Used for TWA Airframe Washing

Four tower-like devices called "Hi-Rangers" make up airframe washing system now in use on all Trans World Airlines planes. Electric motors drive towers over, under or around aircraft. Workmen (above, cleaning a Super Constellation) control tower ranges up to 40 ft. Cleaning time takes 35 man hr., costs about $100. Six men form washing team.

WHAT'S NEW

Reports Available:

The following reports were sponsored by the Office of Technical Services, United States Department of Commerce, Washington 25, D. C.

Development of a Foam Product for Protection Against Thermal Effects—by J. J. McBride, J. D. Medler, A. Petrunti and F. Testa, Evans Research and Development Corp. for Quartermaster Research and Development Command, U. S. Army. June, 1957: $1.75; 66pp.; (PB 131287).

The Development of New Foam-Compatible Dry Chemical Extinguishing Powders—H. B. Peterson, R. L. Tuve, R. R. Neill, J. C. Burnett and E. J. Jablonski, Naval Research Laboratory. September, 1957: $.75; 29pp.; (PB 131165).

Study of the Application of an Electrolytic Tank To 3-Dimensional Asymmetrical Bodies (As Applicable to Aircraft Icing)—by W. L. Torgeson, A. F. Kitchar and B. F. Hill, Research, Inc., for Wright Air Development Center, U. S. Air Force. March, 1956: $1.25; 43pp.; (PB 111792).

An Experimental Distributed Power Amplifier—by S. K. Meads, Naval Research Laboratory. August, 1957: $.50; 19pp.; (PB 131164).

Study of the Oxide Cathode in Demountable Vacuum Systems—by G. A. Haas and J. T. Jenson, Jr., Naval Research Laboratory. August, 1957: $.50; 11pp.; (PB 131129).

Final Report on the Detection of Small Optical Density Changes—by D. G. Kilpatrick and B. Chance, University of Pennsylvania for Office of Naval Research. June, 1956: $.50; 11pp.; (PB 131015).

Publications Received:

Realities of Space Travel—edited by L. J. Carter—Pub. McGraw-Hill Book Co., 330 West 42nd Street, New York 36, N. Y. $7.50; 431 pp.

This basic handbook on the science of astronautics is written on a semi-technical level and presents material which has previously been available only to a selected audience.

The Great Deterrent—by Sir John Slessor—Pub. Frederick A. Praeger, Inc., 150 East 52nd Street, New York 22, N. Y. $6.00; 321 pp.

Lectures, articles and broadcasts on strategic policy in the nuclear age.

***TRANSLATION: You Can't Beat The Bendix "Supermarket"**

From our "supermarket" of precision components, we offer you these advantages on temperature-compensated tach generators: *Fast delivery* because of volume production; *Laboratory quality* due to extensive test facilities and high-precision manufacture; *Latest developments*, such as miniaturization, integral motors, wider range of temperature compensation, etc. Our complete line assures you of getting tach generators best suited to your needs.

NOW! FRAME SIZES 10 AND 15 ADDED TO TACH LINE NEW!

Bendix Tach Generators are linear to within 1/10 of 1% over a wide-speed range; are available over a temperature range of —55°C to +125°C with output voltage stable to 1/10 of 1%; motor generators also available.

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CAB Accident Investigation Report:

Crash Probe Finds Improper Tab Setting

A Lockheed Lodestar, model 18-56, owned by the C. R. Vose Co., crashed, exploded and burned at 0642[1] July 10, 1957, during takeoff at the King Salmon, Alaska, Airport.

All occupants, two crew members and four passengers, were killed. The aircraft was destroyed.

HISTORY OF THE FLIGHT

At King Salmon on the morning of July 10, 1957, about 0615, following two weeks in Alaska on a combined business and pleasure trip, Mr. C. R. Vose and party boarded N 45378 as its passengers. The flight crew of the executive Lodestar was Pilot Edward Coligny and Mechanic-Flight Engineer Ralph L. Hughes. The Vose party contemplated a flight to Anchorage, Alaska, the first segment of its return trip to Seattle, Wash.

Earlier that morning Mr. Hughes had filed a VFR flight plan to Anchorage which proposed a departure time of 0630 and a routing to Anchorage over Airway Green 8 at an altitude of 6,000 ft.

The flight plan also showed that the flight duration would be 1 hr. 40 min. at a cruising speed of 170 kt. and that there was sufficient fuel on board for 6 hr. 30 min.

At 0638, following a period of engine runup on the parking ramp, the flight called the King Salmon tower for taxi and takeoff information. The duty controller cleared it to runway 11 and furnished the latest wind and altimeter conditions: "Wind east-northeast 8; altimeter 29.90." There being no other traffic, N 45378 was cleared directly onto runway 11 where several persons saw it pause one to two minutes and heard its propellers run through one or two times.

Steep Climb

The takeoff was started at 0642 and it seemed entirely normal as the aircraft left the runway surface and climbed to between 75 and 100 ft. The landing gear, however, remained extended. The climb continued normally although somewhat steeper to between 150 and 200 ft., at which time the climb of the aircraft steepened rapidly but smoothly until it was nearly vertical. At the peak of the climb the aircraft pivoted counterclockwise, plunged to the ground, and exploded. An intense fuel-fed fire followed.

The airport traffic controller alerted the USAF emergency equipment located on the base and the fire was quickly extinguished; however, not before the aircraft was nearly destroyed.

[1]Times herein are Alaska standard based on the 24-hr. clock.

Weather conditions at King Salmon at the time of the accident were clear, visibility 60 mi.

INVESTIGATION

Investigation by the Board revealed that the Vose party arrived in Alaska on June 27 and had visited numerous locations prior to July 7 when they landed at King Salmon after a flight from Nome. Until July 10, the morning of the accident, the group visited friends and relatives near King Salmon. N 45378 remained parked on the airport ramp at King Salmon.

On July 9, Alaska Aeromarine Co., acting according to instructions from the Lodestar crew, added 220 gal. of fuel to that already aboard the aircraft. The refueling attendant stated that because 91/98 octane fuel was the highest grade available at King Salmon, a situation which was known to the crew having landed there earlier during the Alaskan trip, he was instructed to add fuel to the rear and auxiliary tanks only. The 220 gal. filled these tanks. The crew told him that there was 100 octane in the front tanks and they did not want it mixed with the lower octane. The front tanks therefore were not opened and the amount of fuel in them at King Salmon is unknown. A refueling slip indicated complete fuel service was performed at Nome.

Flight reports and maintenance log sheets recovered from the wreckage showed that no maintenance discrepancies of significance had been experienced during the Alaskan trip. Witnesses said there was no work accomplished while the aircraft was parked at King Salmon and one recalled a crew member's remark when the flight arrived on July 7 that N 45378 was "fine."

On July 10 the Vose party of six was returned to King Salmon by commercial pilots in three light aircraft. The pilot and flight engineer arrived first about 0600 and thereafter were noticed moving about the aircraft in preparation for departure. Pilots of the light planes noted that baggage, estimated to weigh about 550 lb. was distributed and placed in approximately equal amounts in the front and rear baggage compartments. Persons who were in contact with the crew and passengers said they all appeared well rested and were jovial in anticipation of their return home.

As soon as the party boarded the aircraft its engines were started and an estimated 10 min. elapsed during which the engines were warmed and power checked. One witness observed Mr. Coligny and Mr. Hughes seated in the left and right cockpit seats, respectively. At 0638 the flight requested and received taxi clearance and thereafter proceeded to runway 11 by a taxi course which required several turns. While approaching the takeoff runway the flight was informed that there was no other traffic and it was cleared directly onto the runway for takeoff. The aircraft taxied into position where it stopped for one to two minutes and the propellers were run through.

The takeoff was observed by four witnesses located at three different places on the airport. These locations afforded three views of the takeoff—a rear view, a side view and a quartering rear view. The witnesses included two experienced pilots and the tower controller. All were in substantial agreement as to the events which occurred.

Ground Roll Straight

The eyewitnesses said the takeoff roll was begun with a smooth unfaltering application of power. The ground roll was straight and the plane became airborne after about 2,000 ft. The transition from ground to air seemed entirely normal and there was no noticeable yaw, pitch or roll. The aircraft assumed a normal climb to between 75 and 100 ft., however, the landing gear remained extended. The climb was somewhat steeper until the aircraft reached 150-200 ft. Witnesses said that at this point as airspeed increased the climb steepened rapidly but smoothly until the aircraft was in a near vertical nose-up attitude. Still there was no noticeable roll or yaw and the path of the aircraft remained approximately over the runway.

The witness located directly behind the aircraft stated that at the peak of the climb, variously estimated as between 500 and 700 ft., he could read the identification of the plane painted on the upper surface of the right wing. The Lodestar then nosed forward slightly and hung momentarily in a steep nose-up attitude with its wing rocking. One witness, the most experienced pilot, said that the aircraft at this position was clearly stalled. Immediately thereafter the aircraft pivoted counterclockwise reversing its heading, assumed a vertical nose-down attitude, and plunged to the ground.

Several additional witnesses saw the descent, their attention called to it by witnesses who saw the entire flight. Still others heard the engines' sound but did not see the plane. Almost all of these persons, including the most qualified pilots, stated that the engine sound indicated continuous development of high power throughout the flight. A few, however, described a reduction of power at the peak of the climb and one or two others stated that they thought one or both engines were malfunctioning. Nearly all witnesses agreed that during the descent there was an engine sound indicating high power.

The crash site was located about 300 ft. to the right of the centerline of runway 11 and approximately 3,850 ft. from the runway threshold. The latter distance is about

one-half the runway length. At impact the aircraft was on a heading of about 290 deg., or approximately the reciprocal of the take-off direction. The high concentration of wreckage, the near horizontal contact of the propeller blades with the ground and the compression nature of the structural damage showed the aircraft struck the ground in a near-vertical nose-down descent. The impact and subsequent fire destroyed much of the aircraft structure. Examination confirmed that the landing gear was extended at impact.

Because of the unusual ascent after take-off great attention was devoted to the examination of the control system and in particular the elevator and the elevator trim tab controls. Investigation in this regard disclosed that the empennage was about 80% destroyed, having fallen directly into the concentration of fire as the fuselage accordioned during the impact. These forces, however, acted to relieve tensions on the control cables and upon examination it was found that all control cables to the empennage were properly attached at both the cockpit and empennage ends. Except where the cables were cut to remove the occupants from the aircraft, the cables were intact. As near as could be determined there was no evidence to indicate jamming or interference of the elevator, rudder, or trim control systems. Similarly, the aileron control cables were found unbroken and properly attached.

Cockpit Controls Checked

The cockpit control settings were also carefully examined. Although all other trim tab controls were positioned normally for takeoff the elevator trim tab indicator was found indicating a setting of 17½ units nose-down. This setting, according to several competent Lodestar pilots, including the chief pilot of the C. R. Vose Co., was abnormal for any flight configuration, especially for takeoff which was normally at or near zero, depending upon the gross load.

The elevator trim tab control setting of 17½ units nose-down as shown by the indicator was pursued by examination of the trim tab control assemblies recovered from the wreckage of N 45378. It was learned that the windings of the control cable on the elevator trim tab control drums in each of the elevator trim tab assemblies corresponded with the control cable windings on the cockpit elevator trim tab control drum. Disassembly of the units and a study of their mechanical operation showed the elevator trim tab of N 45378 was positioned for an extreme nose-down condition when the units were recovered. Thus, this examination further revealed the cockpit indicator showed an indication which corresponded closely to the trim tab position.

The elevator trim tab is connected on the Lodestar aircraft directly to a shaft screw which extends or retracts as the control cable rotates the trim tab control drum. Because of this mechanical design the position of the shaft screw is not susceptible to displacement by impact. On N 45378 the position of this unit corresponded to the 17½ units nose-down indication of the cockpit indicator.

Cockpit positioning of the elevator trim tab setting is accomplished by a crank-type control located on the pedestal just below

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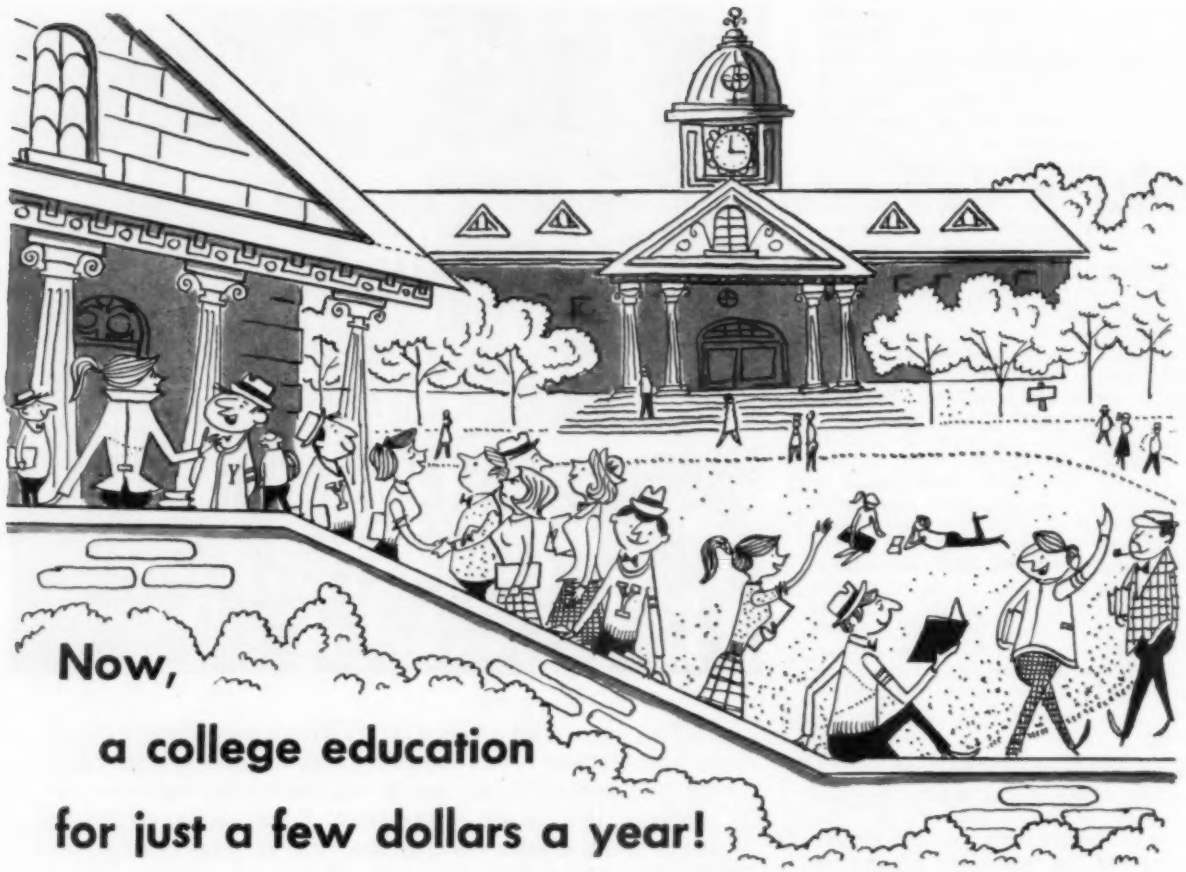

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the throttles when set in the idle position. An arrow moves with the cranking action pointing to the trim tab setting, which is displayed as units of nose-up or nose-down adjustment. The range of adjustment is from 25 units nose-up to 25 units nose-down. Clockwise turning of the crank produces nose-up trim and the reverse, nose-down. Examination of the indicator of N 45378 showed the numerical graduations were clear and easily readable even after the accident.

All other cockpit control positions of the subject aircraft were found normal for the takeoff configuration except for the landing gear handle. This was found in the down and locked position, thus corresponding to the actual position of the landing gear. This was not considered normal because it showed no attempt had been made to retract the gear after the aircraft became airborne.

Evidence showed that all major components of the aircraft and all flight control surfaces were within the immediate wreckage.

It also was determined that all doors and access panels were closed on impact. No evidence was found to indicate structural failure or fire in flight.

Engines Buried

The powerplants of N 45378 were torn from their mounts and buried approximately four feet in the sandy soil by vertical impact. These units were removed from the wreckage site to a sheltered location suitable for examination.

Nearly all cylinders were removed from the engines for inspection and to permit examination of the interiors of the engines. This revealed normal operation of the cylinders prior to impact and clear evidence of adequate lubrication of all components. Examination of the screen and magnetic plug revealed no foreign material. The inspection also showed that damage was the result of impact and there was no evidence of malfunction or failure.

The blades of both propellers showed deep scratches and bending in evidence of high rotational forces at impact. Also, deflection of one or more spider arms of each propeller was indicative of appreciable power. Markings on the propeller shim plates made by impact showed the propeller blade angles were those commensurate with equal and appreciable development of power from the engines.

Weight Discrepancy

Testimony of the Vose chief pilot indicated that the allowable gross takeoff weight for N 45378 was 19,500 lb. This, however, was not substantiated by the records on the aircraft kept by the Civil Aeronautics Administration. The latest CAA Form ACA-337, dated Feb. 25, 1957, listed the allowable gross takeoff weight as 18,500 lb. Further review of this form with regard to work performed on the aircraft at the time, and in light of Aircraft Specification No. A-723, showed that N 45378 substantially qualified for the 19,500 lb. weight, including being equipped with 1820-72 engines. Nevertheless, application, inspection of the aircraft and certain requirements concerning aircraft manuals for the increased gross weight as required by CAR No. SR-407 had not been complied with.

Investigation of the loading condition of N 45378 at the time of the accident of necessity required an approximation of the amount of fuel in the front tanks and the weight of baggage. Assuming a minimum weight of 550 lb. of baggage and that the front tanks were at least one-fourth full, together with other accepted weights from the latest weight and balance data, it was evident that N 45378 was loaded to at least an approximate gross takeoff weight of 19,500 lb., or about 1,000 lb. overloaded. This load was, however, properly distributed with respect to the center of gravity limitations of the aircraft.

Because of the abnormal ascent of the aircraft the possibility of a sudden weight shift was actively considered. Witness testimony and locations of baggage in the wreckage disclosed the load had been correctly distributed and the baggage had been properly placed in the baggage compartments. There were no large single items aboard to cause a shift of weight which could account for the flight path of the airplane. Rescue personnel found that although passenger seats were torn free, all occupants were in seats with safety belts fastened at the time of impact. They also confirmed that Mr. Coligny and Mr. Hughes occupied the left and right cockpit positions, respectively.

A triangular wedge-type external elevator-rudder control lock was found at the perimeter of the fire area. This item was undamaged except that the side facing the fire was scorched and its paint was blistered. Suspecting this lock may have been on the empennage during flight the investigators pursued this as a possibility. From the chief pilot of the Vose organization it was learned that the lock was merely surplus equipment and no longer used as a gust lock on N 45378. He stated that the Lear rudder system was on the aircraft and when this modification was accomplished in early 1957 a new locking system was also installed. He said the design of the system which held the yoke rearward would make it virtually impossible for Mr. Coligny to take his seat with the locking system engaged. Further, turns during taxiing as were made by the aircraft would be very difficult with the lock engaged. Investigation showed that this locking device was not in place in the cockpit after the crash and there was no indication it was in place prior to impact.

Records indicated that the Lodestar, at the time of the last ACA-337, had received a 1,500 hr. inspection. This, among other things, included an inspection of the airframe, control system, the installation of the Lear-type rudder and the installation of two new engines. On Feb. 25, 1957, following completion of the work, the aircraft was test flown and returned to service. From then until the accident the aircraft had been flown about 215 hr.

Yoke Forces

Statements were obtained from experienced Lodestar pilots concerning the yoke forces which could be produced by various settings of the elevator trim tab controls. These were to the effect that the trim tab forces are very powerful and that certain improper trim tab positions would produce forces which the crew may not have been able to overcome if they were surprised and did not take prompt corrective action. In two instances pilots reflecting personal experiences stated they had taken off with the elevator trim tab inadvertently positioned for a full-flap landing. They stated that shortly after becoming airborne they experienced a very powerful rearward pressure on the yoke. This occurred rapidly enough that an element of surprise was introduced. The pilots said that except for an immediate change of trim they believed the force would have been too powerful to overcome. One pilot said his plane reached a steep nose-up attitude and although his corrective action was prompt the aircraft nearly stalled.

In its accident investigation work the

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Board has found that at least two Lodestar accidents resulted from improperly positioned elevator trim tabs during takeoff. In both instances witness' descriptions of the flight paths of the aircraft were nearly identical to the descriptions given of the flight path of N 45378.

The Vose chief pilot testified that Pilot Coligny had been a personal acquaintance of his for many years and that Mr. Vose employed him on April 1, 1957. Records on Mr. Coligny indicated that at this time he had accumulated more than 10,000 flying hr., with about 1,000 in the PV-1 and Lodestar aircraft. Following employment, the chief pilot flew with Mr. Coligny for approximately 100 hr. He stated that during this time, Mr. Coligny's operation of the aircraft was satisfactory and described him as an accomplished and conservative pilot. In response to questions he said the subject aircraft was equipped with a pretakeoff checklist and that from his observations he noted it was Mr. Coligny's habit to use it.

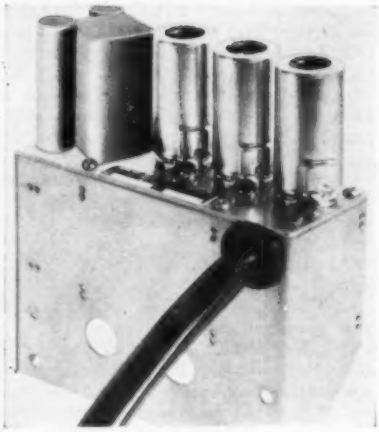
ANALYSIS

At takeoff N 45378 was loaded to an estimated weight of 19,500 lb. CAA records indicate that the aircraft substantially qualified for this weight but no application had been made for it. Thus, the aircraft was certificated for only 18,500 lb. and was therefore overweight approximately 1,000 lb. at takeoff. Since the aircraft was qualified for the higher weight and the load was properly distributed it is obvious the additional weight would not adversely affect its operation and was not a factor in the accident.

During the Board's investigation every consideration was given to the various causes which could produce the steep ascent of the aircraft. In this regard, numerous possibilities such as load shifts, control malfunction and locked controls were exhaustively pursued and virtually eliminated by clear and cumulative evidence. Further, the very nature of the flight path, which was straight without roll or yaw, and which reached an approximate height of between 500 and 700 ft. in less than 4,000 ft. of forward movement, clearly eliminates the possibility of malfunction or failure of either or both powerplants. Furthermore, exhaustive examination of these units revealed they were capable of normal operation prior to impact. The Board determined by clear and cumulative evidence that any changes in power sound which may have been heard during the short flight of the aircraft must have been caused by throttle movement rather than powerplant malfunction.

An analysis of fuel consumption from Nome to King Salmon, based on the amount of fuel added to the rear and auxiliary fuel tanks at King Salmon, reveals considerable amounts were burned from each of these tanks en route. The considerable nose-up trim required during a normal landing would be increased by this apparent fuel scheduling. From an operational consideration it is therefore believed that the trim position during landing at King Salmon, if not changed for takeoff, and if coupled with surprise and delayed corrective action, would produce a nose-up force that could not be overcome manually.

The possibility of an improperly positioned nose-up trim condition is also suggested by the setting found after the crash, 17½ units nose-down. According to reliable



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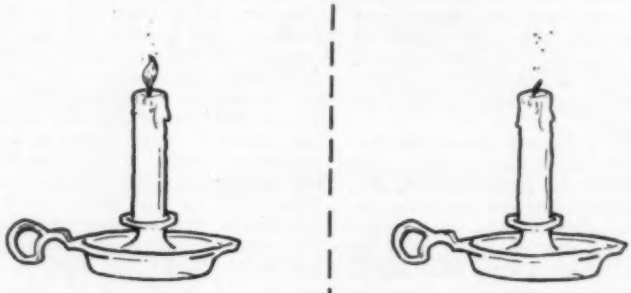

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statements and testimony, the setting does not relate to any normal flight configuration for the aircraft. Operationally, the flight path as described could not have occurred had this nose-down setting existed during the takeoff. Believing the condition was not the result of impact, it is very probable that it resulted from a desperate attempt of the crew to relieve the yoke pressure without regard to obtaining a specific setting.

The improperly positioned nose-up trim setting is suggested by similarity between the flight path of N 45378 and the flight paths of other aircraft that crashed because of this condition. The condition also is suggested by the similarity of the early part of the flight to those in which accidents nearly resulted from the condition.

After careful consideration and analysis of the available evidence, it is the belief of the Board that this accident was the result of taking off with the elevator trim tab positioned for landing.

FINDINGS

On the basis of all available evidence the Board finds that:

1. The aircraft and crew were properly certificated.
2. The flight, after being cleared, began a takeoff from runway 11 in clear weather conditions at the King Salmon Airport.
3. The aircraft was loaded about 1,000 lb. in excess of the allowable gross takeoff weight; however, the load was properly distributed and the excess weight was not a factor in the accident.
4. After becoming airborne the aircraft assumed a normal climb attitude to about 100 ft.
5. As airspeed increased the climb steepened smoothly but rapidly until the aircraft was climbing in a near vertical nose-up attitude.
6. The aircraft stalled at an altitude of between 500 and 700 ft., pivoted counterclockwise, and plunged to the ground in a vertical nose-down attitude.
7. Examination of the cockpit trim tab control indicator and actuating mechanism of the elevator trim tab revealed the tab was set to 17½ units nose-down.
8. The above elevator trim tab position is abnormal for any usual flight condition, especially for takeoff, and resulted from a desperate attempt to relieve yoke pressure.
9. The rearward yoke pressure resulted from the elevator trim tab being positioned for landing during the takeoff.

PROBABLE CAUSE

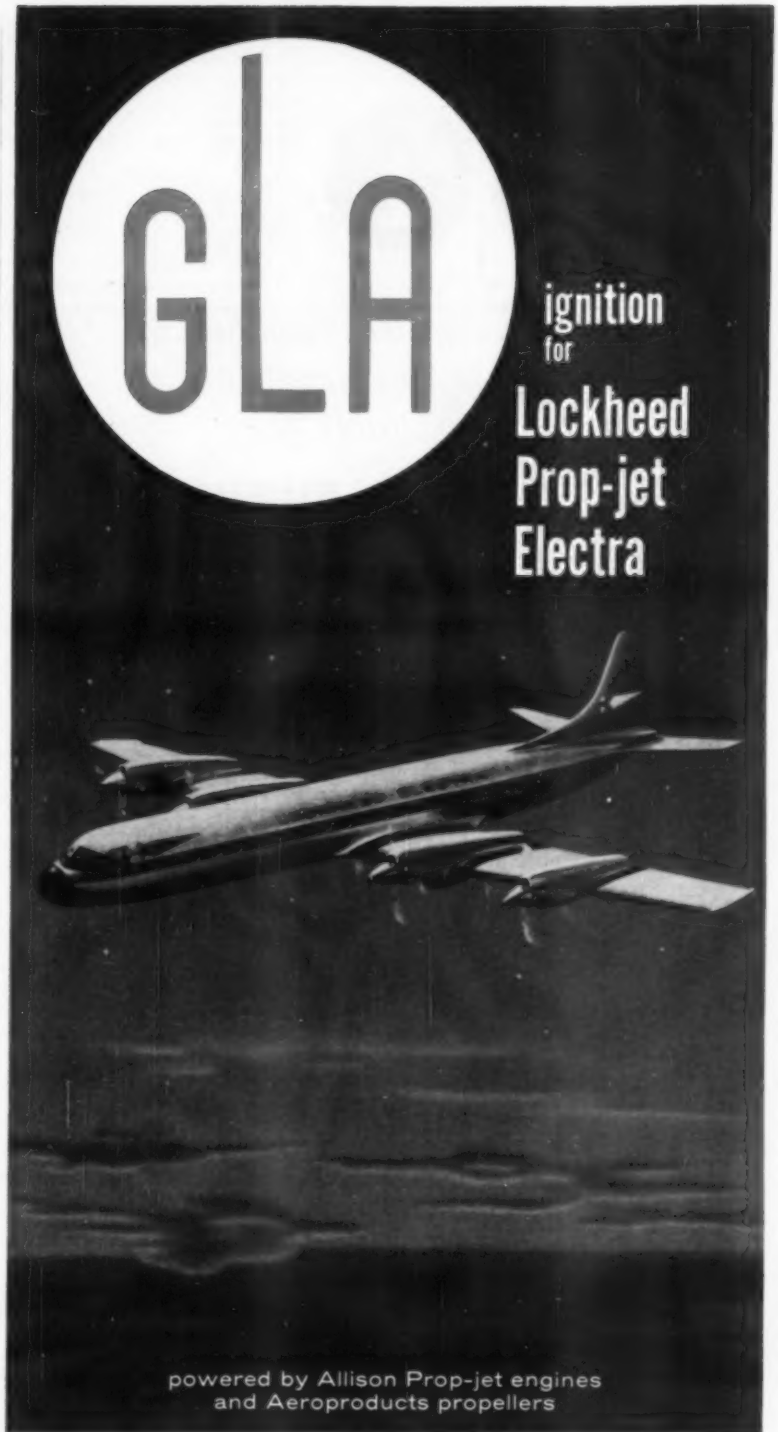
The Board determines that the probable cause of this accident was the pilot's action in taking off with the elevator trim tab positioned for landing.

By The Civil Aeronautics Board:

James R. Durfee
Chan Gurney
Harmar D. Denny
G. Joseph Minetti
Louis J. Hector

SUPPLEMENTAL DATA

The Civil Aeronautics Board was notified of this accident through CAA facilities about 0800 July 10, 1957. An investigation



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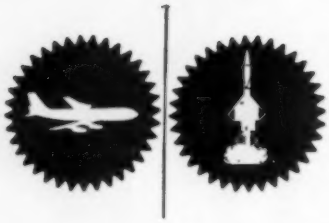

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was immediately initiated in accordance with the provisions of Section 702 (a) (2) of the Civil Aeronautics Act of 1938, as amended.

Depositions were taken at King Salmon, Alaska, on July 20, 1957, and in New York, N. Y., on Aug. 16, 1957.

Operator

The C. R. Vose Co. is an insurance brokerage organization domiciled in New York, N. Y. It owned N 45378 as its only aircraft which was used in furtherance of its business.

Flight Personnel

Edward Coligny, age 49, had been employed by the C. R. Vose Co. as a pilot since April 1, 1957. He held a currently effective airman certificate with airline transport rating. Mr. Coligny had accumulated approximately 10,000 flying hr. He was first rated on Lockheed Lodestars in August, 1953, had accumulated about 1,000 hr., of which 160 were in N 45378, between April 1 and the accident date. Mr. Coligny was rated in the DC-3 and A-26 aircraft and held numerous other airman ratings. His latest CAA first-class medical certificate was current and dated Nov. 5, 1956. It carried the following limitation, "Holder shall possess adequate correcting lenses while exercising the privileges of airman certificate."

Ralph L. Hughes, age 45, had been in the employ of the company for several years as a flight engineer and mechanic on N 45378.

He held a valid airman certificate and ratings as a flight engineer and as a mechanic on aircraft and aircraft engines. Mr. Hughes' principal responsibility was to maintain the Vose aircraft.

The Aircraft

N 45378, a Lockheed Lodestar, model 18-56, serial number 2506, was owned and operated by the C. R. Vose Co. It was purchased new Nov. 23, 1945, by Mr. Vose and at the time of the accident had accumulated 4,181 flying hr. An airworthiness certificate issued July 17, 1956, stated, "Remain in effect as long as the aircraft is maintained in accordance with Civil Air Regulation Part 43." Records showed the aircraft was properly maintained. Last overhaul of the aircraft was completed Feb. 25, 1957, during which two new Wright engines, model R1820-72, and two overhauled Hamilton Standard propellers, models 33D50-111 with model 6511A-12 blades, were installed. The last 100 hr check was completed May 5, 1957.

R. F. Gompertz to Head Rocket Engineering Unit

Richard F. Gompertz, resigned last week as director of Air Force's Rocket Engine Test Laboratory, Edwards AFB, Calif., to accept the post of manager of rocket engineering at General Electric's Malta, N. Y., plant. He is being succeeded at Edwards by USAF Col. Harold W. Norton, former deputy chief for weapon systems at ARDC's Ballistic Missile Division.

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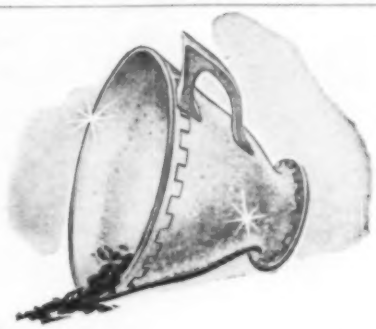

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ENGINEERS

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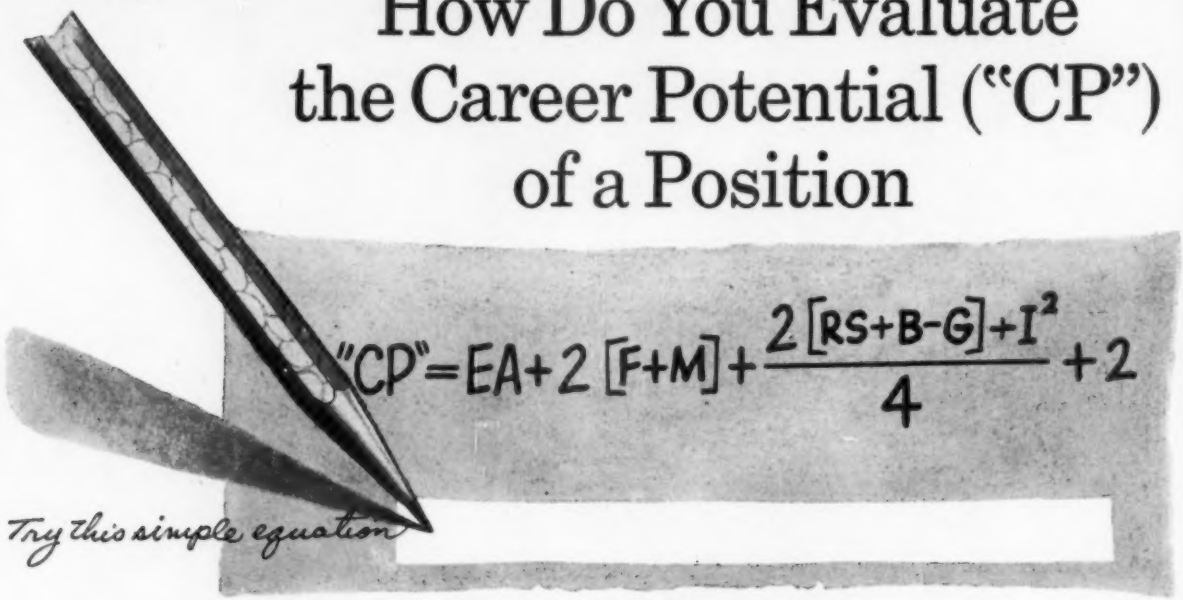

My Present "CP"=_____

	"CP" VALUES	LOW			HIGH
E	Encouragement to Exercise Initiative & Creative Imagination	2	3	4	5
A	Assignment (Nature of)—from Routine to Very Challenging	5	6	7	8
F	Field—Conventional Product to Area where Technical Breakthroughs Expected	2	3	4	5
M	Modern Facilities—from Limited to Extensive Equipment for Testing and Research	2	3	4	5
R	Recognition of Individual Contributions—Chief Reason for Advancement	2	3	4	5
S	Salary—from Unsatisfactory to Excellent for Level of Work	5	6	7	8
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We stock, overhaul, and install

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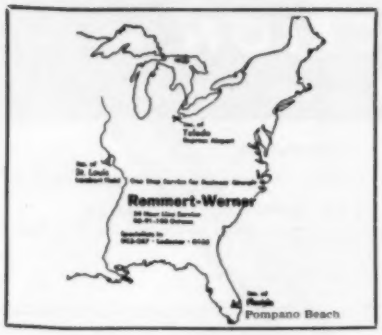

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CINCINNATI, 37—2005 Seymour Ave.
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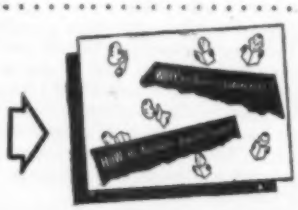

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McGRAW-HILL PUBLISHING COMPANY
330 W. 42nd St., New York 36, N. Y.

One of a series of ads prepared by THE ASSOCIATED BUSINESS PUBLICATIONS

LETTERS

Engineering Affair

We hate to say anything that would in any way tend to throw cold water upon Mr. McMorrow's love affair with Engineering (AW Jan. 27, p. 122), but if he will disengage his arms from around her neck for a moment I think he'll find that he hasn't been engaged in a caress but in a stranglehold. It is true that there are people who can make themselves useful and find challenging opportunity in spite of the failings of supervision in defining such opportunities for them. It may also be that some people are challenged more easily than others. In any case, it is management's responsibility to see to it that the talents of engineers are properly utilized—not to suggest that they forget about the whole thing and lose themselves in a passionate embrace with a hot soldering iron.

Irving Maron
Delaware Twp., N. J.
Donald C. Kaufmann
Blackwood, N. J.

Clear Thinking

I've been reading Aviation Week for some five years since I've been employed as Supervisor of Tech Publications for an aircraft instrument manufacturing firm.

I compliment you on your clear thinking and forceful expression in few words. You have the guts to stick your neck out and today there seems to be less and less people who dare to do so.

I speak only for myself but I'm here to say I appreciate your editorials and general policy of the entire magazine. Good luck and long may you wave.

Charles E. Gardiner, IRE
Bayside, N. Y.

Education Lags

I read your "Hope of the Nation" editorial (AW Jan. 6, p. 21) about Langford with much interest.

Without undue paternal pride, would like you to know that my boy, age 15, has developed similar capabilities, mainly from close study of Aviation Week and similar publications over a period of the last four years. To his credit, also, while I have urged application in the electronics field, he has been more interested in aeronautical engineering. This tendency arose from interest developed as a result of my work at Ogden Air Materiel Area.

Our concern is with getting him into one of the well-equipped engineering schools and developing these interests adequately.

It seems that the entire nation's business world is crying for the government to sponsor (finance) basic and applied research to the tune of billions of dollars. This I support. No one worries (I have seen no criticism in print) that this is socialized research. Maybe the 10% profit on all expenditures is sufficient palliative.

However, when the President indicated recently that federal funds should be made available to insure higher education for more youngsters, Utah's fine Gov. Clyde quickly announced that federal funds were not desired for such a purpose. He has not, however, complained against research and other federally-sponsored projects brought into the state to subsidize farmers, construction of highways, aircraft and missile production facilities, airports, or defense research or production. While he is an educated (college graduate) man, he apparently does not believe in the adage that the truth will set the world free! He would rather they (youngsters) not know the truth than receive it through federally financed education.

It is my belief that education lags because new techniques (new?) such as films, closed circuit TV, training aids (visual aids, breadboards, simulators, mobile trainers, mockups, cutaways and other demonstrated training methods) are 30 years behind the times. We trained over 10 million (additional) men during World War II. Special interests now are afraid that they will not be able to continue to control establishment of new schools, utilization of new techniques if plenty of money is released for whatever good purposes may be found.

Incidentally, you passed up a newsman's opportunity in not working out something for Langford. Apparently he has an IQ of about 150, capable of high school completion and ready for college entrance in about two years. He certainly was entitled to more than a free copy of Aviation Week and first name mention in the editorial. Tell him to look in on State of Illinois' new ideas of teaching math. They might stimulate and help each other.

USAF Civilian
Roy, Utah

P. S. Congratulations on your articles on Maser and Atomic Amplifier (pre-amp for 3,000 mi. radar) particularly your disclosure of radars in operation.

Aviation Week welcomes the opinion of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42 St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Incredulous Economy

Sputniks are not the only thing the Russians have passed us by with.

Two years ago we possessed the world's largest turbojet helicopter, the YH-16A. Now the Russians have their Mi-6, the British have their Fairey Rotodyne, and what do we have? Other than the S-58 and H-21, which are not in this class, all we have is a two-year-old canceled contract—for "economy" reasons—and plastic models in the hobby shops.

In your Jan. 20 issue, p. 32, you state Gen. Gavin recommends a helicopter for the U. S. Army equivalent to the Soviet's Mi-6. In December of 1955 Gen. Gavin was present at the public demonstration flight in Philadelphia of the YH-16A, on order for the Army. It was the second prototype of the higher powered, greater capacity (69 troops) production version—the YH-16B.

But because of an error on the part of a Washington official whereby it was believed maintenance costs to be 10 times greater than actually so, and, at that point, the extravagant reversal of mind favoring smaller helicopters, the contract was canceled.

The fact that the prototype crashed minutes before completion of its Phase 2 tests, after having attained the unofficial altitude record of 24,000 ft. and descended autorotation to 800 ft. should have had no bearing on the cancellation, as it was conclusively proven that failure of test equipment, not fault in the design or construction of the ship itself, caused the crash.

Harold W. Peterson, pilot of the craft, who had 5,200 hr. flying time, 1,000 of them in helicopters, and had spent six of the 11 years he was in the Air Force in Flight Test Division, was very satisfied with the performance of the YH-16, and certainly its capability and appearance was (and still would be) superior to any other in the world.

Budgetary limitations, according to Gen. Gavin, are still preventing production of any helicopter able to compete with the Mi-6. If it has become obvious that, after two years of allowing the USSR to catch up and pass us by, with this as well as satellites, we do need such an aircraft. To continue such "economy" would seem incredulous.

Mrs. Harold W. Peterson
Lancaster, Calif.

Landing Fees

I have read with a great deal of interest, your article in the Dec. 16 issue (p. 38) regarding the use of the O'Hare Airport in Chicago.

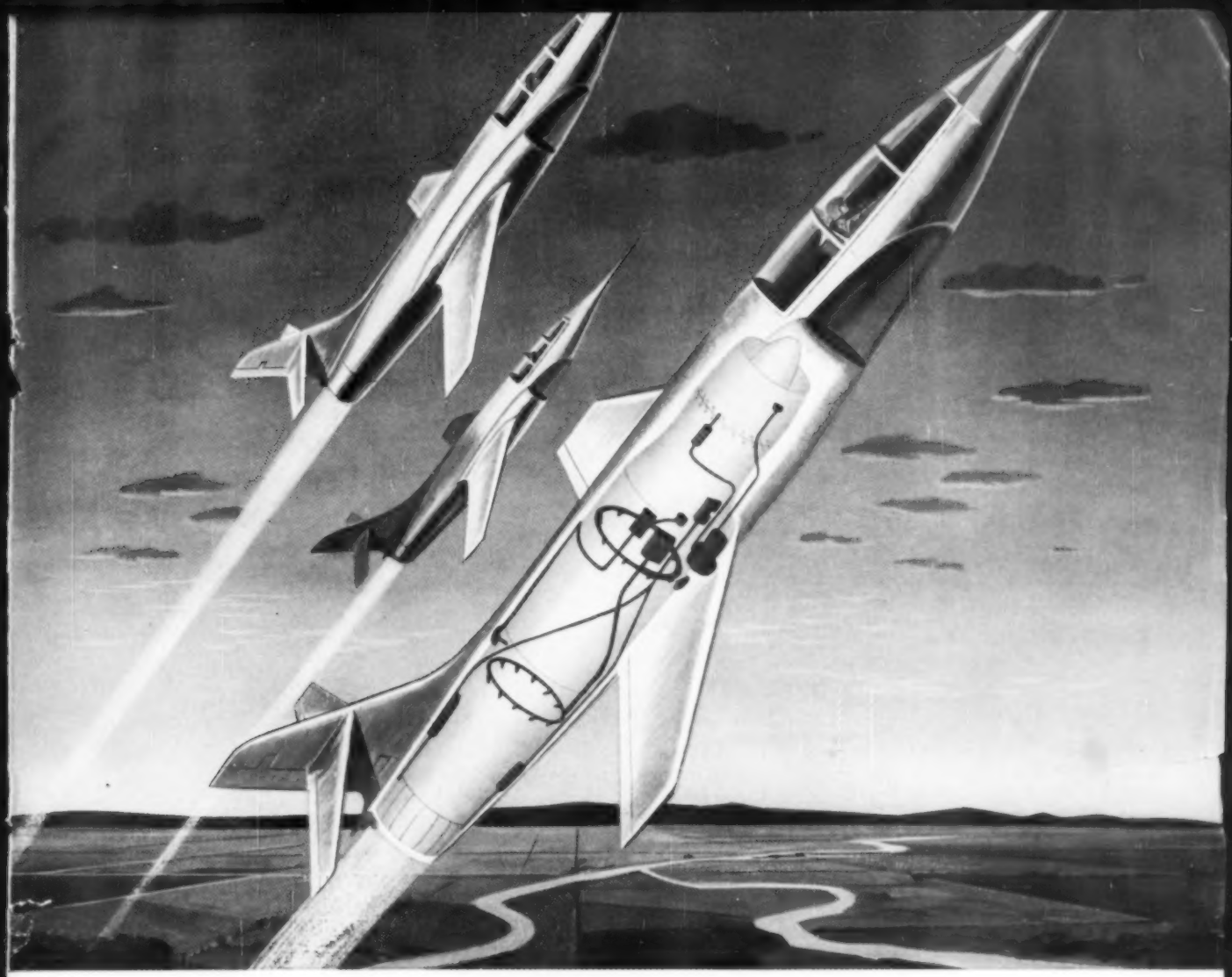
In all of my flying in and out of Chicago, I have yet to find it possible to either leave Chicago or return at the O'Hare Airport. The O'Hare field is much closer to our plant than Midway. Those of us that are located on the north side of Chicago would much rather use it than Midway. I find that the planes in and out of O'Hare are either tourist flights or those that make the intermediate stops. In other words, there seem to be very few through flights.

Have heard rumors that the landing fees at the O'Hare Airport are higher than those at Midway which does not encourage the airlines to make use of the O'Hare field. It would be interesting to know whether this is an actual fact.

We north siders, I am sure, would back any effort that was made to expand the plane service from O'Hare Airport.

Lawrence J. Smith, Director of Research
Bell & Gossett Co., Morton Grove, Ill.

(Landing fees at Midway are less than those at O'Hare because operating agreements signed by the airlines for O'Hare service reflect the rise in costs over the period when long-term agreements were signed for Midway service. Airlines also must share on a pro-rata basis any annual deficit at O'Hare, so it is to the industry's advantage to increase flight volume as an important means of reducing that deficit.—Ed.)



TOWARD MACH 3

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When the pilot swings the lever from idle to emergency thrust—or back again—things must happen fast in the big jets.

But not too fast!

For, pouring it on, or cutting back faster than the engine can take it, spells disaster. The penalties are ruinous over-temperatures, compressor stall or flame-out.

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So, when it comes to fuel metering and engine controls, think of a complete and integrated system. Then we suggest you think of Bendix and the Bendix Products Division.

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